report

Second Annual ARM[illegible]BING PSYCH[illegible]FERENCE

[illegible]-[illegible] 1956

ARMY MEDICAL RESEARCH LABORATORY
FORT KNOX, KY

SPONSORED BY:
CHIEF OF RESEARCH AND DEVELOPMENT
OFFICE OF THE CHIEF OF STAFF
DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT
WASHINGTON 25, D. C.

CRD/J

December 21, 1956

SUBJECT: 2nd Annual Army Engineering Psychology Conference Report

TO: See Distribution

1. This report is the record of the 2nd Annual Army Human Engineering Conference, 7-9 November 1956, and is published for the information and retention of the personnel and agencies indicated in the distribution list. The Conference was attended by the personnel listed in Appendix I of this Report and was sponsored by the Office of the Chief of Research and Development at the Army Medical Research Laboratory, Fort Knox, for the purposes indicated in paragraph 2 of Chapter II.

2. Experience during the year which has elapsed since the first such Army conference has confirmed expectations of the benefits to be derived from improved programs in the development agencies to make new weapons and equipment ever more compatible with the skills and abilities of the troops who will use them.

3. This second conference indicates further development through expression of a noteworthy interest of the CONARC Boards in bringing information from user tests to bear on improvement of human factors in design.

4. As a result of this Conference, actions are being taken on major matters in accordance with its recommendations:

a. to expedite by all practicable means the publication of the Joint Services' Human Engineering Guide for Equipment Design, and to initiate plans for its periodic up-dating;

b. to establish an appropriate working group to formulate recommended course content, student qualifications, and administrative procedures for the training of officers in human factors engineering and engineering psychology to bridge the gap between the design engineer and the psychological research scientist;

c. to establish means for appropriate human factors scientists to make observations of Arctic and ice-cap operations for purposes of improved statements of human factors R&D requirements; and

d. to develop means for estimating cost differentials resulting from human factors engineering changes.

FOR THE CHIEF OF RESEARCH AND DEVELOPMENT:

T. J. CONWAY
Brigadier General, GS
Director of Research

Distribution:
One copy to each member of the Conference
Army: DCS/MO (2); DCS/P (2); DCS/L (2); TAG (3); TSG (10); COFORD (10); COFENGRS (10); TQMG (10); COFT (2); CSIGO (10); CCMLO (10); ORO (5); HumRRO (5)
Navy: ONR (5)
Air Force: DCS/D, R&D (5)
DOD, Misc: OASD, R&D (2); AFSWP (2); NWC (2); ICAF (2); ASTIA (2); AFEB (2)

CONFERENCE REPORT
2ND ANNUAL ARMY ENGINEERING PSYCHOLOGY CONFERENCE

7, 8, 9 NOVEMBER 1956
AT
ARMY MEDICAL RESEARCH LABORATORY
FT. KNOX, KY.

TABLE OF CONTENTS

2ND ANNUAL ARMY ENGINEERING PSYCHOLOGY CONFERENCE

ARMY MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

7, 8, 9 NOVEMBER 1956

I.—AGENDA

7 NOVEMBER 1956

1.	0800--0930	REGISTRATION (Conference Room, AMRL)	
2.	0930--0935	OPENING REMARKS AND INTRODUCTION OF COLONEL FRANKEL.	Col. Charles S. Gersoni, MSC, Chairman R&D Division, OTSG
3.	0935--0950	ADDRESS OF WELCOME	Col. Henry Frankel, Assistant Chief of Staff, G-2, for Maj. Gen. John L. Ryan, Jr., Commanding General, The Armored Center
4.	0950--1000	INTRODUCTION OF DR. ROLLEFSON . . .	Brig. Gen. Theodore J. Conway Director of Research, Dept. of the Army
5.	1000--1020	ADDRESS	Dr. Ragnar Rollefson Chief Scientist, U. S. Army
	1020--1040	. . . . . Coffee Break	
6.	1040--1110	SUMMARY OF ARMY ACTIONS TAKEN ON RECOMMENDATIONS OF PREVIOUS CONFERENCE.	Dr. Lynn E. Baker Human Factors Research Division, OCRD
7.	1110--1145	THE SURGEON GENERAL'S RESEARCH IN BASIC PSYCHOPHYSIOLOGY.	Col. Charles S. Gersoni, MSC, R&D Division, OTSG
	1145--1300	. . . . . Lunch . . . . (Fort Knox Officers' Country Club). . .	
8.	1300--1330	ORGANIZATION OF WORKING GROUPS: A - JSSC Handbook for Design Engineers B - Training of Army Officers in Engineering Psychology C - Human Factors in Design of Equipment for Night Operations and for use in Arctic Climates	
9.	1330--1600	VISIT PSYCHOLOGY LABORATORIES, AMRL.	
10.	1600--1700	MEETING OF WORKING GROUPS.	
	1800--2100	. . . . Social Hour--Buffet Supper . . . . . (Fort Knox Officers' Turret Mess) . . .	

8 NOVEMBER 1956

11.	0800--0845	ORDNANCE CORPS R&D IN ENGINEERING PSYCHOLOGY.	
12.	0845--0930	SIGNAL CORPS R&D IN ENGINEERING PSYCHOLOGY.	
	0930--1000	. . . . . Coffee Break	
13.	1000--1045	QUARTERMASTER CORPS R&D IN ENGINEERING PSYCHOLOGY.	
14.	1045--1130	CHEMICAL CORPS R&D IN ENGINEERING PSYCHOLOGY.	
	1130--1300	. . . . . Lunch . . . . . (Fort Knox Officers' Country Club) . . .	

15.	1300--1345	CORPS OF ENGINEERS R&D IN ENGINEERING PSYCHOLOGY	
16.	1345--1430	TRANSPORTATION CORPS R&D IN ENGINEERING PSYCHOLOGY	
17.	1430--1700	CONARC BOARDS' REQUIREMENTS FOR ENGINEERING PSYCHOLOGY R&D	
		a. Board No. 1:	Lt. Col. Paul C. Swafford
		b. Board No. 2:	Capt. Bruce H. Robertson
		c. Board No. 3:	Maj. Alfred J. Millard
		d. Board No. 4:	Capt. Edward J. Fishle
		e. Board No. 5:	Col. Raymond H. Bates
		f. Board No. 6:	Maj. C. C. George
	1830--	. . . . . Dinner.	
		. . (Fort Knox Officers' Brick Mess). . . .	

9 NOVEMBER 1956

18.	0800--0915	MEETING OF WORKING GROUPS	
19.	0930--1015	REPORT OF WORKING GROUP A -- JSSC Guide for Design Engineers	
	1015--1030	. . . . . Coffee Break	
20.	1030--1115	REPORT OF WORKING GROUP B -- Training of Army Officers in Engineering Psychology	
21.	1115--1200	REPORT OF WORKING GROUP C -- Human Factors in Design of Equipment for Use in Arctic Climates	
	1200--1330	. . . . . Lunch	
		. . (Fort Knox Officers' Country Club). . .	
	1330--	Departure during afternoon of 9 November	

II.–INTRODUCTION

References and Background of the Conference, and Summary of Opening Remarks of Col. Charles S. Gersoni, MSC, Chairman, and of Col. Henry Frankel, Assistant Chief of Staff, G-2, (representing Major General John L. Ryan, Jr., Commanding General, Ft. Knox.)

1. References:

a. "Conference Report of the Army Human Engineering Conference," the Pentagon, 14-15 December 1955, recommended that such a Conference be established as an annual event, and that it should be Army-wide with both Army "user" and development agencies as participants.

b. Letter from C/R&D to CONARC dated 23 August 1956 subject: "Second Annual Army Engineering Psychology Conference," and similar DF, same subject, dated 10 July 1956 to the technical services, established the purposes and dates of the Conference to be held at 7, 8 and 9 November 1956 at Army Medical Research Laboratory, Ft. Knox, Ky.

2. Purpose of the Conference (per reference b, above):

"- - - to provide for interchange of information between working level scientists from human engineering R&D facilities and appropriate representatives of user services by:

a. providing opportunity to observe investigations in progress at the Army Medical Research Laboratory;

b. presentation and discussion of research accomplishments of the technical services since the previous conference, together with presentations of their future research and development plans in this field; and

c. discussions of mutual problems, and development of recommendations for the improvement of human engineering R&D in the Army."

3. Welcome to Ft. Knox and the Army Medical Research Laboratory (AMRL) was extended on behalf of Major General John L. Ryan, Jr., Commanding General of Ft. Knox, by Colonel Henry Frankel, ACS G-2, The Armored Center, who also briefly described the mission and organization of Ft. Knox and AMRL, hosts of the Conference.

4. The Chairman, Col. Charles S. Gersoni, MSC, then introduced Brigadier General T. J. Conway, Director of Research, Office of the Chief of Research and Development, D/A.

III.–ENGINEERING REQUIREMENTS FOR HUMAN FACTORS R&D

Summary of Introductory Remarks of Brigadier General T. J. Conway, Director of Research, and Address of Dr. Ragnar Rollefson, Army Chief Scientist.

1. General Conway pointed out that the Army's research and development program, directed in many complementary fields, is expected to contribute directly to its primary mission: Success on the Battlefield. He noted that achievement of this mission depends in the end on only two factors, men and materiel; and reminded the Conference that, whereas in previous wars we have been able literally to overwhelm our adversaries with sheer quantity of these, it is likely that in future it will be their quality which must determine the issue in our favor. In particular he expressed concern here with the "subtle wedding of the man with his equipment," and recommended this to the conferees as the key factor in the whole problem worthy of their continuing concern. He cited the sponsorship of the Conference by the Office of the Chief of Research and Development as evidence of the Army's keen interest in this field and of its confidence that such research and development can make important contributions to the total team effort. In further token of this interest and confidence, he introduced as the "keynote" speaker of the Conference the Army's Chief Scientist, Dr. Ragnar Rollefson.

ON ARMY ENGINEERING REQUIREMENTS FOR HUMAN FACTORS R&D.

Address by Dr. Ragnar Rollefson

In addition to bringing the Army's official expression of interest in these proceedings, I have been asked to say a few words about how a physicist or gadgeteer feels about human engineering. I am sure there is only a small chance that I can say anything of consequence that is not already familiar to you. However, the difference in point of view and difference in illustrations may make the attempt of some interest.

My first experience with human engineering was probably typical. The knobs and dials on a piece of equipment had been rearranged in accordance with the specifications of a group of psychologists. The result was certainly satisfactory, but my reaction as well as that of my engineering associates was, "Why, of course. That's just common sense. You don't need a Ph.D. psychologist for that!" It was probably true in this simple instance that once the difficulty was pointed out, a physicist or engineer could have made the change.

What we were overlooking, and I hope overlook no longer, is that recognizing the need for a change and the possibility of making one is often by far the most important step. If a psychology Ph.D. is required for this step, we had better have him.

The above example is typical of what I like to call "butches" on the part of engineering designers, which have been fixed up by the psychologists. Such fixes are, of course, a minor part of the activity of a specialist in human factors engineering. To me, at least, the subject of human factors engineering seems to be very complicated and difficult to cover with a simple orderly list of topics. One possible way to subdivide the subject, and this is one which emphasizes a point I wish to make, divides the field into three parts, depending on the nature of the task.

Task 1 is to insure the compatibility of man and machine. This is the one most commonly discussed and illustrated.

Task 2 is to insure that the work is properly divided between man and machine. I have the impression this one is often forgotten in the urge toward automation.

Task 3 is to secure the optimum efficiency and capability from the combination of man with machine. I have the impression activities in this field have been largely impromptu, intuitive, and perhaps unconscious although they have been stressed by some of the leaders.

In any particular development these three may all be involved to varying degrees. A fairly pure example of task one, that of insuring compatibility of man and machine, is furnished by knob and dial placement. Other examples are the determination of the size, shape and location of operators' controls, or the arrangement of equipment in a room. In general, the object is to increase convenience to the operator and avoid confusing him.

I have the impression that there is much more need for this type of activity than the average person realizes. During the last few days, that is during the time I have been thinking about what to say at this meeting, I have run across a suprisingly large number of cases of obviously bad human factors engineering. Many of them have been in situations which had long been familiar to me but which I had never before approached from the "human factors" point of view. For example, the newspaper last Sunday reported that thousands of intended votes are never recorded by voting machines because people return the levers to their original positions before leaving the booth, not realizing that this cancelled their votes and that the lever which opens the curtain also records the vote and resets the machine. I have myself, many times had a strange unsatisfied feeling as I left the voting booth. I realize now that this feeling would have been eliminated if there had been a button to press which would record the vote and reset the machine so that I could see the levers flipped back to their original positions before I opened the curtains. It seems to me that the labor saving device of having the recording of the vote, the resetting of the machine and the opening of the curtain all on one lever is a menace rather than a boon because it leads to confusion of the operator.

Important as compatibility of man and machine is, it seems to me that it constitutes only a small part of human engineering and that tasks two and three may in the future be of much greater significance. From a mechanistic point of view, human factors engineers have as their working material by far the most impressive machine ever created, the human body. Perhaps their foremost task is a critical study of the characteristics of this machine, its aptitudes, capabilities and limitations. Once these are known, the problem of maximizing the effectiveness of the combination of this human machine with those we can construct should be easier. There are some things for which the man should be used, and some which are more efficiently done by a gadget, and the correct choice can be of great importance. Let me illustrate by some examples.

As a radar antenna scans, reflections from nearby objects cause changes in frequency of the transmitter. If the receiver is tuned for a particular frequency the set will be improperly tuned through most of the scan and may be so far out of tune in some directions that the signals disappear. A man can tune only by watching the height of fixed signals, so that for him to keep the set tuned during scanning at the rate of several complete turns per minute is obviously impossible. However, a device called an automatic frequency control can be constructed with parts which can be held in the palm of one hand. This device is sensitive to frequency difference and has a time constant of a small fraction of a second so that it can keep the receiver in almost perfect tune with the transmitter throughout the scan. This is a case where the man's capabilities are obviously not suited to the job and the electronic device is ideal.

However, if we shift our attention to pattern recognition we find the tables turned. A man can do amazingly well, even without special training, while even the most complicated machines can show only a very rudimentary form of pattern recognition. An example I used with my laboratory classes to convince them they could estimate small fractions of a division accurately is the following: Take a rectangular piece of clean paper and make a pencil mark at what you estimate is the middle of one side. Then fold the corners to coincide to check your mark. Most students' marks would be within a millimeter of the correct position, or within less than one percent of the length of the side. To make an electronic device which will do as well requires an impressive array of equipment, and it should be used only if consideration of the whole system shows it to be desirable in spite of its complication.

The above examples are admittedly extreme ones in which it is easy to decide where to use man and where the device. I feel certain, however, that one can expect the human factors engineer of the future to be faced with many problems of this type where the distinctions are more subtle, but where the correct division of tasks between man and machine is no less important.

If we turn now to task three, that of securing the optimum combination of man and machine, we might say that it is actually implied by task two, but I have separated them partly for emphasis and partly because I feel there is a real difference. To me, securing the optimum combination involves close cooperation between the human factors engineer and the design engineer from the beginning of the design phase to insure that the machine is designed to make proper use of the skills and aptitudes of the operator, whether these skills be native or acquired through training. As a simple example, and one with which I am sure you are all familiar, I can cite the study which showed that there are eight different knob shapes which can be differentiated without error by the sense of touch, even with gloves. Employment of these shaped knobs in the cockpit of an airplane makes use of a sense which might otherwise be wasted and can be expected to increase the overall capability of an operator. As a second example, consider the excellent work which has been done on aircraft altimeter dials. This work showed that the common method of using several different hands on a dial was time

wasting and even confusing, and that a linear scale with a single index was a great improvement. So far, this is an excellent example of category one, that is, of avoiding confusion by proper design. Suppose now we went a step further and represented altitude by the separation of a movable from a fixed line. This would make use of the pilot's pattern recognition ability and might be a most effective way of getting him to comprehend the essentials rapidly. Whether this particular change would actually be an improvement or not is a matter for investigation, but it at least illustrates the use of a capability which is otherwise wasted.

As a third example, and one not intended to have direct military application, consider the juggler. To reproduce his feats by means of an electronic device, if it is indeed possible, might be expected to require an array of equipment the size of the Pentagon. If we are thinking of the proper division of labor between man and machine, this is clearly the place for a man.

The implication of this example in the optimizing of the man-machine combination is evident When one compares the astounding feats of the juggler with what an average operator is called upon to do, it is clear that the operator is not being used to capacity. To be sure, in most cases he shouldn't be, but perhaps we could do some highly desirable, but otherwise impossible things if we intentionally made more and better use of the capabilities of the operator.

In any event, I should like to suggest that for many situations it would be advisable to try to make use of the unique capabilities of man rather than to try to replace him by gadgets.

There remain a few special points which I should like to mention, without taking the time to relate them to the general framework of these remarks. The first is that what is good human engineering under some circumstances may be bad under others. For example, when I worked in the galley of a freighter the cook was forever telling me, "Use your head to save your feet." For her that was good human engineering - she weighed 450 pounds. For me it was nonsense - after work in the evening I used to run a mile or more on deck. In a similar vein, it is not necessarily doing a man a favor to shower him with labor saving devices - especially if his difficulty is that he is bored by not having enough to do.

For the next few points I believe no illustrations are necessary. I have become reconciled to the fact that the design engineer cannot be depended on to do the following things without assistance or prodding from a human factors specialist:

(1) Design equipment so that it demands the least possible training for maintenance men.

(2) Design information displays so that they can be readily interpreted by a soldier with a minimum of special training.

(3) To greatly simplify equipment by making best use of skills and aptitudes which all soldiers normally possess.

On the other hand, I believe the human factors engineers must be careful to see that the men are not trained so as to nullify the best efforts of the design engineer. I can give an example from airborne radar. When a radar antenna is high over the water, interference of the beam reflected from the water with the direct beam gives a pattern such that the echo from a target plane disappears every few scans. When reports came in that certain airborne radars were not seeing airplanes I went to investigate. On my scope I repeatedly watched the target plane come in from 50 or 60 miles but it was never reported to the plotting board. On further inquiry I found that the scope watchers were instructed not to report targets unless they showed for a certain minimum number of scans in succession, and that minimum number was greater than the number of hits between fades in the interference pattern. Here was a case where well designed equipment was being wasted by training which was not applicable to the situation.

I should like to summarize these few remarks as follows:

(1) While proper matching of controls and display devices to the operator is an important job for human factors engineers, it is perhaps even more important to be sure that the natural skills and aptitudes of the man are not wasted or mis-used.

(2) Good human engineering will take into account variations in individuals and in conditions.

(3) Important advances can be made by optimizing the division of tasks between man and machine so that the potentialities of each are used to best advantage.

(4) The Army needs competent help in the field of human factors engineering and knows it.

IV.–SUMMARY OF ACTIONS TAKEN ON RECOMMENDATIONS OF PREVIOUS CONFERENCE

1. It was pointed out that the Department of the Army attaches considerable importance to these Engineering Psychology conferences and anticipates a number of benefits from them. For that reason, and because it was recommended by the previous conference, it is planned (a) that they be held annually; (b) that they shall, each year, prepare recommendations for improvement of Army research and development of human factors in engineering; (c) that they shall each year receive "feed-back" as to actions taken or planned on previous recommendations; and (d) that the Conference Report serve as an annual compendium of Army R&D accomplishments and future plans in this field.

2. Summary of actions on recommendations of the previous (14-15 December 1955) Conference was presented in accordance with Table 1., pages 10 - 12.

TABLE 1.

SUMMARY REPORT TO 2nd ANNUAL ARMY ENGINEERING PSYCHOLOGY CONFERENCE ON MAJOR RECOMMENDATIONS OF ARMY HUMAN ENGINEERING CONFERENCE The Pentagon, 14-15 Dec. 1955, AND ON ACTIONS RESULTING THEREFROM

LYNN E. BAKER

RECOMMENDATION	ACTIONS		TARGET DATE
	TAKEN	TO BE TAKEN	
1. Augment Army participation by working design engineers from the Army Technical Services in JSSC preparation of the Human Engineering Guide for Design Engineers. (Conference Report, page 15)	a. D/F from C/R&D to TQMG, C/Ord, CSigO, C/Engrs, CCm10, & C/T, dtd 13 Mar 56, subj: "Joint Services Steering Committee for the Human Engineering Guide to Equipment Design" requests designation of representatives for review of "Guide" chapters who are, or have available to assist them, working design engineers. b. Letter from Army Member, to Chmn, Exec Council of JSSC dtd 3 May 56, subj: "Army Participants in Human Engineering Handbook Review," based on replies to above, informs all concerned of Army's designated tech service participants & authorizes procedures for direct contact.	Based on Army reviews (info cys to OC/R&D) of "Guide" chapters, monitor production of "Guide" via Exec. Council, JSSC	Continuing
2. Invite CONARC's consideration of the advisability of its Boards' participating in the work of the Committee. (Conference Rpt, page 15)	a. Ltr fr C/R&D to CONARC dtd 7 May 56, subj: "Participation of CONARC Boards in Work of the JSSC for the Human Engineering Guide," outlines the problem & requests CONARC cmts on advisability of participation by CONARC Bds in critical review of Guide chapters. b. 1st Ind fr CONARC, dtd 29 Jun 56, concurs in participation of CONARC Bds (including Arctic Test Br, Ft Greely, Alaska), & suggests channel for action. c. Memo dtd 19 Jul 56 fr Army Mbr, Exec Council, JSSC to its Chmn, subj: "Army Participants in Hum Engr Handbook Review" establishes channel per CONARC suggestion.	Same as 1., above	Continuing
3. The Guide should present its information in a simple form which can be quickly consulted on specific design problems. (Conference Rpt, page 15)		Dispatch ltr fr Army Mbr to Chmn, JSSC requesting that guidance in these terms accompany distr of chapters to critical reviewers	

RECOMMENDATION	ACTIONS		TARGET DATE
	TAKEN	TO BE TAKEN	
4. Investigate distr outside Ordnance Corps of the Semi-Annual "Ord Engr for Troop Operational Factors" on trial basis. (Conference Rpt, page 18)	No action deemed advisable at this time.	Reopen question in Working Gp A of 2nd Annual Conference	8 Nov 56
5. Incorporate specific human factors requirement in technical cmte actions. (Conference Rpt, page 18)		This provision will be contained in a revision of AR 705-5 which is expected to be published early in '57.	Jan '57
6. Provide for visual displays for improved understanding & reduction of prose, especially in annual R&D Progress Rpts (RDB Card 613) (Conference Rpt, page 18)	No action deemed advisable at this time		
7. Determine means for periodic preparation & distr of a bibliography of published documents on Hum Engr subjects.	Scope & availability of non-Army bibliographic info, reviewed; no action deemed advisable at this time to effect Army distributions of these materials.	Obtain complete annual bibliographies of their hum engr publications fr Tech Servs for incorporation in Annual Conf. Rpt	31 Dec '56
8. Rqt Ord Corps, & any other agency in the Army which develops Hum Engr Handbooks or check lists of hum factors, to make these available to the CONARC Bds as well as distr within own agencies. (Conference Rpt, page 18)	HEL, Ord., & QMRL have advised that they will do so (conversations: Dr. Ben Ami Blau at APG on 29 Mar 56, & Dr. Robert S. Woodbury at Natick on 24 Apr 56.)		
9. Provide suggested distr list on hum engr matters to interested officers of the tech servs. (Conference Rpt, page 19)	No action deemed advisable at this time.		

RECOMMENDATION	ACTIONS		TARGET DATE
	TAKEN	TO BE TAKEN	
10. Determine advisability of forming a National Rsch Council Cmte on Hum Engr (Conference Rpt, page 19)	No action deemed advisable at this time.		
11. Establish Army Hum Engr Conference on an annual basis (Conference Rpt, page 19)	Done - See title of present Conference.		
12. Determine Army Needs for "Hum Engr Specialists" (Dr. Fitts' proposal, Conference Rpt, page 20)	a. Ltr to CG, CONARC dtd 23 Apr 56 fr Ch, OPRDiv for C/R&D subj: "Graduate Tng in Hum Engr" cites Dr. Fitts' recommendation & fwds Lt Col John E. Aber's ltr of 29 Mar 56 on same subj for info with suggestion that needs for such tng be evaluated for officers to serve in CONARC hq & with CONARC Bds. b. DF dtd 19 Apr 56, subj as above to tech servs, does substantially the same with suggestions that requests for such tng be processed in accordance with AR 350-200.	Follow-up recommendations of Working Gp B of this Conference	

V.–SUMMARIES OF TECHNICAL SERVICE PRESENTATIONS TO THE CONFERENCE

1. The Surgeon General's Research in Basic Psychophysiology: Col. Charles S. Gersoni, MSC, Chief, Research Division, Office of the Surgeon General.

Col. Gersoni described the Surgeon General's program in this field as consisting of two coordinated parts: a contract portion monitored by the Research Division in Washington, and an in-service portion conducted by the Psychology Department of the Army Medical Laboratory, Ft. Knox.

a. Contract Research of TSG: Dr. Phillip I. Sperling, Research Division, OTSG.

Dr. Sperling described the contract research program of TSG in this field as augmenting and complementary to the in-service work of AMRL. An Advisory Committee on Psychophysiology, meeting two or more times per year to evaluate research proposals and progress, is composed of: Dr. Frank Geldard, University of Virginia; Drs. Harold Schlosberg and Lorrin Riggs, Brown University; Dr. William A. Hunt, Northwestern University; Dr. Eliot Stellar, Pennsylvania School of Medicine; Dr. Merle Lawrence, Michigan University; Dr. Dewey Neff, University of Chicago; and Dr. William Kappauf, Jr., University of Illinois. With technical guidance furnished by this advisory committee contract researches are now under way as follows:

(1) Dr. Edward Girden, Brooklyn College: an investigation of precision of a sensing mechanism in a tracking performance under conditions of extreme fatigue.

(2) Dr. John Paul Nafe, Florida State University: investigations of physiological mechanisms involved in the experiencing of heat and cold.

(3) Dr. Merle Lawrence, University of Michigan Medical School: study of the effects of over-stimulation and various internal factors on the function of the inner ear.

(4) Dr. Richard Henneman, University of Virginia: effects of stimulus encoding and other conditions determining efficiency of multiple-task performance, variables influencing choice behavior in simple response situations, and role of response restriction in the perception of ambiguous stimuli.

(5) Dr. Mason N. Crook, Tufts University: effects of visual noise on the perception of forms in electro-visual display systems.

(6) Dr. Robert B. Malmo, McGill University: relations between steepness of Electro-Muscular Galvanometer gradient and "level of arousal."

(7) Dr. Donald B. Lindsley, University of California: temporal factors in visual perception and exploration of certain related features of auditory and tactual perception.

(8) In addition to the above, proposals are now under study for other contract research including, especially, studies of the effects of vibration on man.

b. Major Areas of Research Under Way or Initiated at AMRL since Previous Conference: Dr. Robert Walker, Chief, Psychology Department, AMRL.

Dr. Walker summarized previously unreported research under way as follows:

(1) Effects of environment and fatigue with respect to various types of driving control mechanisms in various types of Army vehicles.

(2) Maximum force expendable in particular body positions by particular muscle groups used with hand and foot controls.

(3) Development of instrumentation for study of visual "white out" effects.

(4) Measurement of error in continuous observation of fluctuating indicators.

(5) Development of a portable laboratory for study of sound and audition in various military environments at various sites.

(6) Extension of completed studies of effects of cold on manual dexterity to include high temperature ranges.

(7) Effects of acclimatization on maze and problem-box performance of animals.

(8) Extension of previously reported studies of effects of tank-turret rotation of crew personnel to include effects of sharp and continuous oscillations in the horizontal and vertical planes.

(9) Determination of extent of possible psychological decrements attributable as side-effects to motion-sickness inhibiting drugs.

(10) Development of a blast tube designed to allow experimental variation of: pressure, from 0 to 200 lbs/sq in; duration of over pressure as a function of compression chamber length (12-1/2 ft to 25, 37-1/2, or 50 ft); and distance from test-cell to diaphragm (33 to 77 ft in 22 ft increments).

The above research set-ups were made available for examination and discussion during the Conference visits to the Psychology Laboratories, AMRL, Agenda Item 9.

2. Ordnance Corps R&D in Engineering Psychology: Dr. Ben Ami Blau, Ordnance Human Engineering Laboratory, Aberdeen Proving Ground, Md.

a. Dr. Blau briefly described the human factors engineering program of the Ordnance Corps as having two major elements:

(1) HEL at APG which, being designated as a central agency for this activity, has Corps-wide responsibility for collecting and disseminating relevant data, for conduct of supporting research studies of general Corps-wide interest, and for general consultation and coordination at the request of specific Corps agencies.

(2) Human factors engineering activities in the arsenal systems, including:

Springfield Armory, where Mr. E. F. Cousineau, staff engineer assigned to this function, has initiated contracts with Tufts University to study factors in use of small arms;

Redstone Arsenal, where Mr. Donald Graham monitors, with help from HEL, broad human factors engineering specifications in contracts for development of missile systems;

Picatinny Arsenal, where an engineering staff section under the direction of Mr. C. Thomas Goldsmith does in-service research and development on human factors problems of packaging materials, artillery and rocket fuzes, and ram-loading and identification of various types of ammunition;

Frankford Arsenal, where a similar engineering staff section studies problems of recoilless rifles and fire control devices;

Detroit Arsenal, where Mr. Alfred Hansen is responsible for human factors engineering of Army vehicles, tracked and wheeled; and

Ordnance Weapons Command, where Mr. Theodore Lorenzen has responsibility for monitoring the human factors engineering activities of Rock Island Arsenal and Watertown Arsenal in addition to those of Springfield Armory as noted above.

b. Effects of Modified M-1 Rifle Sights on Marksmanship at Low Levels of Illumination: Dr. Wesley C. Blair, Ordnance Human Engineering Laboratory, Aberdeen Proving Ground, Md.

Dr. Blair reported procedures and apparatus used, and results obtained, in testing which of a set of 8 modified M-1 rifle sights might prove to be optimal under both high (50 ft candles) and low (1 ft-candle) levels of illumination of targets. Results confirmed other findings that the standard M-1 sight gives good performance under high illumination but poorer performance under low illumination, and that sights presenting wider (3.5 - 4.5 mm) apertures and modified gold or white-faced 3 mm-wide front posts or white ring appeared superior for both conditions of illumination. A field test of these results will be undertaken.

c. Human Engineering Evaluation of the Mock-up Equipment of the LACROSSE B Forward Guidance Station: Dr. Stanley L. Revesman, Ordnance Human Engineering Laboratory, Aberdeen Proving Ground, Md.

Dr. Revesman's presentation (classified CONFIDENTIAL) described the conduct and results of an evaluation whose purposes were: reduction of likely operator-error, increase of efficiency in terms of time and motion for setting-up, and determination of effects of fatigue and environmental factors on setting-up efficiency. A total of some 25 design modifications were recommended as a consequence of this work, and the HEL has been requested to continue over-all evaluation of the system.

3. Signal Corps R&D in Engineering Psychology: Mr. Paul Griffith, The Signal Corps Engineering Laboratories, Ft. Monmouth, New Jersey.

Mr. Griffith outlined the current status of SCEL's human factors engineering program as concerned with: applications to the training of engineers in basic principles of human factors engineering; the review of equipments that have not had the benefit of this approach in their design; insuring that SCEL R&D contractors recognize the need for and apply human factors principles; and providing consultative services to Laboratory personnel. A 40-hour course, with one 20-hour semester on "Man-Machine Systems" and a second on "Man-Machine Tasks," has been established and about 25 engineers enrolled; wide distribution has been given in SCEL to the NEL "Human Engineering Guide" and to WADC Technical Report 56-218, "A Guide to the Design of Electronic Equipment for Maintainability." Over 30 equipment designs have been reviewed from a human factors standpoint in the past year: about 75% of the recommendations have resulted in modifications, in a few cases amounting to radical design revisions. A standard paragraph on human factors, published in Alex Javitz's article "Human Engineering in Equipment Design" (Electrical Manufacturing, Oct '56), has been incorporated in over half of SCEL's R&D prime equipment procurement documents since January '56; detailed monitoring of progress of work under such contracts is being done to assure conformance, and to indicate what revisions of the paragraph may be advisable in future to convey more specific information and to indicate the bases on which contract work will be evaluated. The consultation work of SCEL's human factors

engineering personnel reveals many requirements for further research to fill gaps in knowledge, e.g.: gloved-hand dimensions are not now available in suitable form for setting design limitations on minimal acceptable inside dimensions for handles and bails; data are sorely needed on power-output of man, such as will be provided by Ordnance Human Engineering Laboratory's study of "Cranking Rate under Various Torque Loads," by AMRL's study (cited in paragraph 1, above) on force exerted by muscle groups on controls in various positions, and by an ONR study being conducted by Franklin Institute on other aspects of this problem. For similar consultative use, SCEL has contracted with Dunlap & Associates, Inc., to produce a series of 2 or 3-page summaries of principles and data applicable to the design of specific types of equipment and not currently available in "guide" form, and the first of the series is expected to be completed within the next 2 months. Emphasis in future will be laid on use in SCEL of system, rather than component-oriented, principles of analysis and design which include the human factor, and on the importance of such factors in evaluation of systems reliability.

4. Quartermaster Corps R&D in Engineering Psychology: Dr. E. Ralph Dusek, Quartermaster R&D Command, Natick, Massachusetts.

Dr. Dusek dwelt primarily on the human factors problems generated by "incompatibilities" which arise between items produced by QM and items produced by other technical services as jointly used by men. To identify such incompatibilities a contract inquiry will be completed in January 1957. Thereafter, to correct the incompatibilities identified, Ordnance Corps, Signal Corps, and Transportation Corps plan a cooperative effort with the Quartermaster Corps to reduce the number of these and to furnish scientist and technical personnel for joint technical service analysis teams. The first of these teams, already discussed as regards Ordnance items by Dr. Revesman (paragraph 2, above), has identified two items of QM interest: problems of manual dexterity in manipulation of certain components, especially when working in darkness or at temperatures requiring the wearing of gloves; and problems of the design of certain QM load-carrying equipment. Beyond correction of incompatibilities once discovered, QM R&D Command is concerned in a "preventive medicine" approach to supply needed basic information to forestall their future occurrence:

a. A report on spatial dimensions of the 95th percentile clothed Arctic soldier is now in press;

b. The above study will now be extended to cover men of smaller proportions and greater detail regarding specific parts, viz, dimensions of the gloved hand.

c. A study is being initiated to determine the limits of reach to body surfaces and changes in body dimensions during such reaches.

d. A hand-book of the hand and its functional characteristics is now being compiled from available data; data are also being collected on strengths of individual fingers and on metacarpal length, digit length, width of hand, and range of finger movement, and will be extended to include effects of limited circulation, sustained effort, and fatigue on hand function; it has been demonstrated that the loss of tactile information occasioned by hand coverings produces an increase of prehensile force in grasping and manipulating objects, and further work will consider resulting fatigue factors; other studies will investigate sensory and preceptual characteristics of the hand.

In conduct of above and future studies, QM R&D Command will stress the general principle that the human factors engineer, while important to achievement of efficient design, is only one member of a team directed to this end.

5. Chemical Corps R&D in Engineering Psychology: Dr. Leonard S. Rubin, Chemical Warfare Laboratories, Army Chemical Center, Maryland.

Dr. Rubin reported that two studies whose preliminary findings were reported to the previous conference have now been completed and published by the American Physiological Society: The Dexterity of the Gloved and Bare Hand as a Function of Ambient Temperature and Degree of Exposure; and The Effects of Atropine Sulphate on Dark Adaptation. Human factors problems of major concern to the Chemical Corps, concerning which studies are planned in the Psychology and Human Engineering Branch of the Directorate of Medical Research, Chemical Corps R&D Command, include:

a. determination of optimal inspiratory-expiratory resistance ratios for gas masks as a function of work rate and ambient temperature.

b. determination of audibility through various mask voice-emitters in realistic ambient noise levels.

c. human factors in the design of gas detection and prophylaxis devices and kits under realistic conditions of climate and luminance.

d. studies of effects on human functional efficiency of prophylactic and therapeutic drugs and devices.

e. psychological aspects of offensive CW, e.g.: "terror" effects of flame weapons; effects of sub-lethal toxic agents on human performance in such modalities as dark

adaptation, audiometric thresholds, monocular peripheral vision and critical fusion frequency, sensory-motor coordination, and higher intellective processes. Preliminary results already obtained on dark adaptation give some indications which may be applicable to field situations in which military tasks are performed under low levels of illumination.

Beyond this, the Chemical Corps as a whole is now establishing a distinct human factors project within its R&D Command to facilitate coordination and integration of the research efforts of various psychobiological disciplines and to provide direct channels of communication and collaboration at all stages from research and development through final engineering tests. The Engineering Command of the Chemical Corps has simultaneously encouraged a projected program to include evaluation of human factors as an important objective of user tests under a variety of climatic conditions; until workload or responsibilities require appointment of one or more full-time professionals in this field, this Command will rely primarily upon consultant services to provide technical guidance on human factors and has appointed Dr. Leonard Mead, Coordinator of Research at Tufts College, to its consultant staff in this capacity. The Chemical Corps Training Command, with primary cognizance for training men in the effective use of offensive and defensive CW materiel, is considered a source of numerous human factors research requirements.

6. Corps of Engineers R&D in Engineering Psychology: Mr. Manfred Gale, Engineer R&D Laboratories, Ft. Belvoir, Virginia.

Mr. Gale reported that the Corps of Engineers maintains no organization or individuals who specialize in human factors engineering. The Corps is, however, at present planning initiation of a program, and have representation at this conference to learn about, rather than to contribute to understanding of these problems. The Corps has, by contract and by dependence on competences available in the other technical services, generated a limited number of specific inquiries on human factors problems, for example as respects mine detection devices. Broader requirements are considered to exist, however, for which the Corps will seek solutions notably as respects: human factors in arctic environments; the development of improved manuals for the guidance of operator and maintenance personnel using Corps of Engineers equipments; and development of safety features which will be effective but not "overdesigned." In general it is clear that, to assure continued satisfactory operation and maintenance of Corps of Engineers items as well as to assure effectiveness of training for these functions, more human factors engineering must be applied in their development.

7. Transportation Corps R&D in Engineering Psychology: Dr. John W. Bailey, Special Projects and Analysis Division, Transportation Corps Research and Engineering Command, Ft. Eustis, Virginia.

Dr. Bailey's extempore comments, fortified with pertinent examples from his rich experience as a student of the great Titchener, as an anatomist, and with the military, described the bases on which human factors problems are treated as appropriate actions of his Division in the Transportation Corps Research and Engineering Command. In doing so, he stressed the importance of the use of simple and direct language for effective interchange of ideas and suggestions between specialists in the various technical and scientific fields.

VI.–SUMMARIES OF CONARC BOARDS PRESENTATIONS TO THE CONFERENCE

INTRODUCTION: ORGANIZATION AND MISSION OF CONARC BOARDS

Col C. W. McConnell, CONARC

Col McConnell described the R&D function of the Continental Army Command: first, in establishing the requirements for research and development, which involves consideration of human factors in the writing of the military characteristics of desired items; and second, at the end of the development cycle, in conducting user tests through the six numbered CONARC boards and the Arctic Test Branch at Ft Greeley, Alaska.

Board No. 1, the Field Artillery Board, at Ft Sill, Oklahoma, tests all conventional artillery, guided missiles and the ancillary equipment associated with the field artillery role, and has a test branch at Ft Bliss;

Board No. 2, at Ft Knox, is an Armor or automotive Board, and tests all automotive and armor equipment and all Corps of Engineer equipment for the field Army;

Board No. 3, at Ft Benning, Ga., is the Infantry Board and tests all items peculiar to the infantry and all items common to the individual soldier, regardless of arm or service;

Board No. 4, at Ft Bliss, is the anti-Aircraft Board, both for conventional weapons and for guided missiles and also for associated fire-direction systems;

Board No. 5, at Ft Bragg, N. C., is the Airborne Board and is also responsible for general communications and electronics testing;

Board No. 6, at Ft Rucker, Ala, is the Army Aviation Board;

The Arctic Test Branch at Ft Greeley, Alaska ("Big Delta"), supports all of the numbered Boards by conducting all appropriate arctic and subarctic tests.

In addition to such service testing, the Boards assist the schools in determining their several requirements, they assist in the writing of military characteristics, and they maintain liaison with and furnish user guidance to the technical services and to contractors throughout development.

1. CONARC Board No. 1 Human Factors Engineering Requirements

Lt Col Paul C. Swafford

Lt Col Swafford presented, as an example of human factors in the design of field artillery equipments, a rear view of T108 in the firing position. The following major components were pointed out as requiring careful consideration in terms of the relevant abilities, skills, and training of cannoneers: ammunition hoist, which lifts the 200-lb projectiles from ground to loading tray or storage racks and has a complex electrical system to serve its four directional controls; power rammer, which requires additional directional electrical operating equipment; power traversing and elevating equipment, with manual alternative operation in case of power failure; horizontal equilibrators, which adjust the level of the piece on a side-hill cant to the horizontal position at the expense of further complications of maintenance. In addition a number of minor components were noted as illustrating human factors problems which come to the Board's attention, including: inaccessibility of a foot-firing switch because of improper sizing of a toe-guard, and uncertainty as to the most suitable type of joy-stick or wheel steering control. Particular stress was laid on the observation that many improvements which reduce the demands on the human skills and abilities of operators do so at the expense of increased demands on maintenance personnel, and numerous examples were given. These and other observations strongly indicate to Board No. 1 the necessity of improved consideration of human factors, especially in the design stage. The work reported at this conference by the Human Engineering Laboratory on the LACROSSE guided missile

was referred to as an excellent example of the value of early consideration of human factors, and Board No. 1 recommends that such work be done at an early stage on all items developed. In conclusion, hearty concurrence of the Board was expressed as to the value of such conferences as the present one as a means of providing interchange of information and a mutual understanding of problems.

2. CONARC Board No. 2 Human Factors Engineering Requirements

Capt Bruce H. Robertson

Capt Robertson discussed observations made at Board No. 2 on opportunities to take improved account of human factors in vehicle design as regards: SPEED - tests have shown that maximum of speeds attainable on any type of terrain are dictated by driver and crew, rather than mechanical, limitations; RIDING COMFORT - fatigue arising from improper design and improperly trained riding habits may well result in significant reductions of performance efficiency; and MECHANICAL APTITUDES - increased capabilities for operating ease have increased the complexity of maintenance but reduced the availability to the Army of skills formerly acquired in the back-yard maintenance of cars of an earlier day; the newer machines relieve the operator not only of a function, but also of the understanding of the purpose and nature of that function. Opportunities for improved consideration of human factors are illustrated in design considerations affecting the job of the commander and crewmen of tanks and other combat vehicles. Thus the tank commander's duties require that, in commanding his own or a group of tanks, he use a radio, read maps, select targets, operate a range-finder, adjust tank-fire, and be able at all times to scrutinize the battlefield and to maintain absolute control of his vehicle or unit. These and other duties create an urgent need for an integrated station for the tank commander. Similarly there is need for development of more efficient instrumentation, space, and controls for the tank gunner taking account of his work space, adequate warning lights, improved bore-sighting arrangements, simplified azimuth indication, and simplified ballistic computer operation. Discharge of the loader's functions can be assisted by improved indication of ammunition types, sizes, and fuze characteristics and by improved time-and-motion characteristics of his work-space characterisitcs. Improvement of the efficiency of the tank-driver can be expected to result from consideration of fatigue problems created in long hours of travel over difficult terrain, by improvement of the instrumentation upon which he depends, by improvement and standardization of his controls, and by improvement of his field and depth of vision. In addition to these improvements related to specific commander and crew duties, there are other general problems affecting all crew members which require improvement. Among the more important of these are: interior illumination, heating and ventilation, communications, and noise and vibration.

In similar fashion there are large opportunities for human factors improvement of other combat vehicles, e.g.: the Combat Engineer Vehicle M 102, which at various times requires crew members to assume new functions; Armored Vehicle Launched Bridge equipment; the armored cab of the D-7 bulldozer; and mine detector-eradicators and mine planters.

In addition to the above requirements specific to particular vehicles, Board 2 is impressed with two propositions of more general interest:

a. There is evidence that some expense of development and procurement may be devoted to achieving equipments whose capabilities far exceed those of their operator personnel. Thus vehicles are developed which are capable of 23-hour operations in every 24 hours, although men are not so capable.

b. Human factors must be taken into account from the beginning of the earliest design phases.

3. CONARC Board No. 3 Human Factors Engineering Requirements

Major A. J. Millard

Major Millard called attention to the military truism that the tactical mobility of any unit in contact with the enemy is geared directly to the battlefield mobility of its forward-most infantryman, and this in turn is either facilitated or handicapped by his burden of weapons and equipment. For this reason, and as emphasized by the load limitation stated in the Equipment Development Guide, work is progressing on reduction of the battle load itself, on improvements in the means of carrying the load, and on the

was referred to as an excellent example of the value of early consideration of human factors, and Board No. 1 recommends that such work be done at an early stage on all items developed. In conclusion, hearty concurrence of the Board was expressed as to the value of such conferences as the present one as a means of providing interchange of information and a mutual understanding of problems.

2. CONARC Board No. 2 Human Factors Engineering Requirements

Capt Bruce H. Robertson

Capt Robertson discussed observations made at Board No. 2 on opportunities to take improved account of human factors in vehicle design as regards: SPEED - tests have shown that maximum of speeds attainable on any type of terrain are dictated by driver and crew, rather than mechanical, limitations; RIDING COMFORT - fatigue arising from improper design and improperly trained riding habits may well result in significant reductions of performance efficiency; and MECHANICAL APTITUDES - increased capabilities for operating ease have increased the complexity of maintenance but reduced the availability to the Army of skills formerly acquired in the back-yard maintenance of cars of an earlier day; the newer machines relieve the operator not only of a function, but also of the understanding of the purpose and nature of that function. Opportunities for improved consideration of human factors are illustrated in design considerations affecting the job of the commander and crewmen of tanks and other combat vehicles. Thus the tank commander's duties require that, in commanding his own or a group of tanks, he use a radio, read maps, select targets, operate a range-finder, adjust tank-fire, and be able at all times to scrutinize the battlefield and to maintain absolute control of his vehicle or unit. These and other duties create an urgent need for an integrated station for the tank commander. Similarly there is need for development of more efficient instrumentation, space, and controls for the tank gunner taking account of his work space, adequate warning lights, improved bore-sighting arrangements, simplified azimuth indication, and simplified ballistic computer operation. Discharge of the loader's functions can be assisted by improved indication of ammunition types, sizes, and fuze characteristics and by improved time-and-motion characteristics of his work-space characterisitcs. Improvement of the efficiency of the tank-driver can be expected to result from consideration of fatigue problems created in long hours of travel over difficult terrain, by improvement of the instrumentation upon which he depends, by improvement and standardization of his controls, and by improvement of his field and depth of vision. In addition to these improvements related to specific commander and crew duties, there are other general problems affecting all crew members which require improvement. Among the more important of these are: interior illumination, heating and ventilation, communications, and noise and vibration.

In similar fashion there are large opportunities for human factors improvement of other combat vehicles, e.g.: the Combat Engineer Vehicle M 102, which at various times requires crew members to assume new functions; Armored Vehicle Launched Bridge equipment; the armored cab of the D-7 bulldozer; and mine detector-eradicators and mine planters.

In addition to the above requirements specific to particular vehicles, Board 2 is impressed with two propositions of more general interest:

a. There is evidence that some expense of development and procurement may be devoted to achieving equipments whose capabilities far exceed those of their operator personnel. Thus vehicles are developed which are capable of 23-hour operations in every 24 hours, although men are not so capable.

b. Human factors must be taken into account from the beginning of the earliest design phases.

3. CONARC Board No. 3 Human Factors Engineering Requirements

Major A. J. Millard

Major Millard called attention to the military truism that the tactical mobility of any unit in contact with the enemy is geared directly to the battlefield mobility of its forward-most infantryman, and this in turn is either facilitated or handicapped by his burden of weapons and equipment. For this reason, and as emphasized by the load limitation stated in the Equipment Development Guide, work is progressing on reduction of the battle load itself, on improvements in the means of carrying the load, and on the

provision of carriers which can accompany the individual and relieve him of his load. In addition, sound design of infantry equipment requires simplicity and reliability of operations; for example, there is urgent need for a range finding device having these characteristics, and Board No. 3 has found that prototypes developed on the coincidence principle are completely compromised by human error or indecisiveness in battlefield conditions. Board No. 3 is primarily concerned with application of these evaluative principles to three families of infantry weapons: the small-arms or flat trajectory family; the high-angle or curved trajectory family; and the antitank family. As to the first we seek a small-caliber, ultra-high velocity rifle shorter in length than the M-1 or T-44, weighing approximately 6 lbs, effective to a maximum of 500 yds, and having a small optical sight with an auxiliary open rear sight and post front sight. It is this Board's belief that the lack of human factors engineering in this area is essentially responsible for the fact that the U. S. soldier is still burdened with a long, clumsy, heavy rifle firing essentially the same heavy cartridge used at the turn of the century. A lightweight, general purpose machine gun is also sought to replace all three of the current standard machine guns. It is hoped that a 23-lb weapon is now available to fill the bill; it will shortly be in the hands of troops and is an excellent example of the influence of human factors considerations in engineering development. In the mortar family, developments are directed to a new family of infantry mortars with increased killing power, uniformity in design, and lightness of weight. In the anti-tank family, we still have not reconciled high killing-power to low weight-requirements. As regards other categories of equipment in the purview of this Board, consideration of human factors has also paid dividends -- for example individual load carrying equipment, designed with the wearer in mind, to give placement of the load near the center of gravity, an even distribution and balance of the load, simplicity of adjustment, and accessibility of pockets and pouches.

It is the view of Board No. 3 that human factors and basic human characteristics must be primary considerations in the design stage for infantry equipment.

4. CONARC Board No. 4 Human Factors Engineering Requirements

Captain Edward J. Fishle

Captain Fishle called attention to the importance of obtaining feedback of information from the user in the field in obtaining improved consideration of human factors in design. This argues a need for personnel trained in human factors considerations at the user test level. To support such personnel in the development of new systems and the improvement of current systems, research on new techniques and principles may be required along the lines now performed by the HumRRO field units as regards training problems.

Human factors considerations of importance to the user of electronics equipments, both requiring equal emphasis and consideration, relate to operating considerations and to maintenance considerations. As respects operating considerations, numerous examples can be cited regarding human factors in (1) arrangement of components - e.g., location and arrangement of controls, meters, switches, dials, and displays with respect to their use by the operator; (2) selection of types of components - e.g., use of standardized and coded controls and displays; (3) complexity of equipment which may exceed human capabilities of perception, action, reaction, and decision; and (4) special environmental conditions as shown, for example, in Arctic and cold weather tests. As respects maintenance considerations, a special factor is of frequent concern with electronic equipments, in that component "wear-out" is not visible and is random in nature. This makes "localizing" the trouble often the primary job, while actual repair often becomes secondary. Human factors therefore must be taken into special account in the design of built-in test equipment and test points, in the location of components, in working and safety requirements, in the types of checks required, and in simplicity and uniformity of design.

In summary, Board 4 would emphasize that greater account must be taken of the human operator and mechanic in future design. As evidenced in NIKE I, the latest and most complex equipment in the field today, many discrepancies that were uncovered by the user could have been averted at an earlier stage by better application of human factors engineering.

5. CONARC Board 5 Human Factors Engineering Requirements

Col Raymond H. Bates

Col Bates cited a number of examples of faulty design from a human factors standpoint noted at Board 5. These included: Early models of Radio Set AN/PRC-10, which required use of two hands for frequency calibration; early models of AN/TCC-7 Carrier Equipment, which required two men to adjust the output of the order wire circuit; a wire-splicing tool whose spring-loaded splicing-sleeve magazine lacks a hold-down lug; Telephone Switchboard SB-86 whose transport case lacks knee-room for the operator when used, as normal, as a base for field use of the board; and Camera KS-6, which required several simple modifications before it could be operated by a photographer wearing arctic mittens. The testing of airborne equipment presents special problems because of the wide range of extremely variable factors which must be considered. A number of films of service tests of aircraft and jumping equipments were shown to illustrate the importance of the design, and error-free use, of static lines and other rigging, and of the critical importance of body positions, check routines, and other human error sources in their operation.

6. CONARC Board No. 6 Human Factors Engineering Requirements

Major C. C. George

Major George presented a number of salient considerations in the application of such engineering to the design and testing of Army aircraft. Board 6 user tests are, in very major part, human factors tests of the compatibility of the equipment with the skills and abilities of pilot, crew, passengers, and maintenance personnel. Thus a poorly designed seat may diminish a soldier-passenger's ability to do his job at this destination; an inaccessible drain plug may reduce the effectiveness of a periodic inspection; or cockpit lighting which reflects on the windshield may cause a pilot to miss a bad-weather night instrument approach. Correct Army aircraft design is conditioned by two conflicting guiding factors: the aircraft must be easy to fly in the stress of battle, so that rapid training of citizen-soldiers is feasible in wartime; but mission requirements demand ever-increasing performance in terms of speed, range, and payload. As examples of the conflict these factors introduce: making the landing-gear retractable increases speed but adds in the cockpit (1) a control to raise and lower the gear, (2) an emergency alternative control for the same purpose, (3) tell-tale lights to show the gear's position, (4) a horn to warn the pilot when he throttles back with gear up, (5) a button to silence the horn, (6) hydraulic valves or electric switches to energize these controls, (7) rheostats to dim the gear-position lights, (8) an index on air-speed indicators showing maximum safe speed for lowering gear, and (9) a number of circuit-breakers which can be manually set by the pilot. Similarly, addition of a second engine improves performance but adds tremendously to the complexity of the pilot's job. Resolving this conflict between improved performance and simplified operation requires human factors engineering of every device which enters the cock-pit. Such engineering must take account of a number of interdependent factors in addition to the complexity already mentioned. Among the most important of these are reliability and safety, stresses resulting from knowledge of the disastrous consequences of error, the persistence of human inadvertance in spite of such disastrous consequences, and the added dangers of combat flying. Three examples of recent and current Board 6 projects in which human factors furnish the dominant features are: determination of the optimum design for team-work of pilot and observer in a new high-performance observation aircraft; testing of a British center-positioned helicopter collective stick which was found to produce error because it caused the pilot to use right hand in an unaccustomed manner; and a program to improve the instrument flying capability of helicopters.

In all of the above matters, Board 6 notes that we have in the past been able to accept certain design deficiencies with a view that the man can adapt to them. It is now becoming increasingly true, however, that the man is the fixed quantity and it is the machine which may be re-designed if necessary.

VII.–SUMMARIES OF CONFERENCE WORKING GROUP RECOMMENDATIONS AND DISCUSSIONS

1. Joint Services Steering Committee Guide for Design Engineers.

a. Report of Working Group A: Dr. Lynn E. Baker, Chairman. "The Working Group wishes to record the following comments and recommendations on the proposed publication by the Joint Services Steering Committee of its Human Engineering Guide for Design Engineers:

(1) It is recommended that vigorous efforts be continued to complete publication of the Guide, and that early consideration be given to establishing procedures for keeping the Guide up-to-date following its initial publication.

(2) The Working Group wishes to endorse and encourage the efforts of the individual Army technical services to adapt such guidance to their particular needs, and recommends that, where appropriate, such materials be exchanged among the technical services and made available for use in periodic revisions of the Guide.

(3) The Working Group notes with approval that the Wright Air Development Center Technical Report 56-218 is being considered for modification and incorporation in the Guide.

(4) The Working Group notes that planned procedures for distribution for user evaluation of the draft chapters of the Guide have not as yet "shaken down" and it is recommended that measures be taken to strengthen these procedures."

b. There being no further discussion from the floor, the Chairman called for the report of Working Group B.

2. Training of Army Officers in Engineering Psychology.

a. Report of Working Group B: Col Herbert C. Hicks, Chairman.

"Mr. Chairman, Dr. Rollefson, General Conway, Dr. Hoyt, Gentlemen -- The problem before Working Group "B" was the training of Army officers in Engineering Psychology. This problem was highlighted in a statement made by Dr. Paul Fitts of Ohio State University to the effect that there is a need for personnel who can bridge the gap between the design engineer and the research scientist (in engineering psychology).

"After considerable discussion it was agreed that sufficient personnel were not being trained in this field, and civilians now being trained do not always grasp the problems peculiar to the military until after considerable time of close association with the military. The training of Army officers in this field was therefore considered to be a step in the right direction. It was agreed that individuals so trained should be utilized with both the technical services and CONARC and its test Boards, with priority to the Technical Services. In addition it was agreed that the inclusion of some instruction in engineering psychology in courses now being conducted at civilian and service schools would be highly advantageous. A further point was made that the Joint Services Steering Committee Handbook for Design Engineers should greatly assist in clarifying some of the problems, and the expeditious completion of same is strongly recommended.

"It was further agreed that the question has such wide implications and ramifications that it would be impossible to work out a solution in the short time allotted to this group at this conference. It is therefore recommended that:

"DCSPER be requested to form, in coordination with OCR&D, a working group consisting of representation of the Technical Services, Department of the Army, and the academic world to determine:

1. The subject matter which should be included in a course for such training.

2. Qualifications which should be required for officers to receive such training.

3. Details of getting such a course implemented and publicized.

4. Ways in which training and indoctrination may be accomplished within and without the Army at all levels.

"It is further recommended that OCR&D investigate possibilities of U. S. Army personnel becoming oriented in this field by attending the short course being organized by the U. S. Air Force."

b. There being no further discussion from the floor, the Chairman called for the report of Working Group C.

3. Human Factors in Design of Equipment for Use in Arctic Climates.

a. Report of Working Group C: Dr. E. Ralph Dusek, Chairman. "This Working Group submits the following comments and recommendations:

(1) Opportunities exist for observation in field exercises in Arctic environments. For example, exercise Moosehorn in Alaska and operation Arctic Night on the icecap have provided information about human engineering problems associated with the

design of specific military equipment. In addition routine army maneuvers are conducted continually in Fairbanks and at Fort Greeley. Such exercises should provide excellent opportunities for human engineering studies in the future.

(2) It is felt by representatives of this group that each service has specific and unique problems influenced by human factors in the performance of their respective equipment in Arctic and icecap operations, the degree of which cannot be resolved at this time. Problems of incompatibilities between items of the various technical services can be best resolved by intercommunication between respective research and development groups and through engineering psychology conferences.

(3) There are requirements for research and development personnel of various technical services to observe human performance with their respective items during Arctic and icecap operations. Such observations will provide more technical information for application of human engineering in present and future modifications of equipment. It is felt that observer reports from such maneuvers are important and useful; however, the design and execution of particular experiments within such operations does not appear feasible.

(4) It is believed that there is an urgent need to develop a methodology for determining the cost differential (cost expressed in broad sense, such as manpower required, dollars, time etc.) resulting from human engineering changes. It is further recommended that the first step in such a program should be a pilot study of human engineering effects using a specific item. This item does not apply solely to design of equipment for Arctic use; it applies "across the board" to all human factors engineering studies."

b. Floor Discussion:

(1) Dr. Crawford, HumRRO: "Mr. Chairman, I was a member of Working Group C, and would like to amplify the 4th recommendation of our Group, which was to the effect that it is important at this time that a careful study be made of some particular human engineering change or set of changes. Such a study would follow these changes all the way through, from the recommendation of the change itself, through its acceptance and installation and through the logistic system, to the user. Thus we might obtain some kind of measure of its cost in terms of trouble to the supply system and perhaps also changes in training- to give us a whole picture of whether the changes were worth while. A pilot study on this would obviously not answer the general question. If, however, a careful selection of one or a few such changes was made and these changes fully studied, we could expect to begin thus to develop some criteria of the "worth-whileness" of human factors engineering changes. I suspect that the answers to such problems would be of value not only to the Army and the military services, but also in industry."

(2) Dr. Rubin, Army Chemical Center: "Is it the view of this Working Group that an item should be followed through from the prototype stage, or that an item which has already been produced be "human engineered" and these changes followed through?"

(3) Dr. Uhlaner, PRB, TAGO: "The way this came about was that members of the Working Group observed that often a change is made in an item which the human factors engineer believes will make it more effective, yet which might result in so great an increase of logistical expense as to far exceed the benefits it gains. Such a study as this recommendation suggests would develop some criteria by which these values could be, so to speak, "netted out in advance" by the R&D administrator."

(4) Chairman: "It appears that this is essentially an operations research type of problem, may we have a comment from Dr. Frank Harris, of ORO?"

(5) Dr. Harris, ORO: "While we in ORO are not centrally concerned with human factors engineering as such, we often become tangentially concerned with it. Certainly, there are aspects of this problem which seem very much in line with our thinking on cost-effectiveness measures."

4. Other, General, Discussion:

a. (1) In response to a question from the floor, the Chairman requested Dr. Paul Fitts to give a brief summary of plans for the Ohio State University short course which is being setup for Air Force personnel.

(2) Dr. Fitts, OSU: "First, it must be recognized that there are several levels at which training is needed, and this course is to meet just one of these needs. The Air Force has requested Ohio State to plan a 3 week short course which would serve as a brief indoctrination primarily for engineers and Air Force officers who are engaged in test programs, or involved otherwise with human factors but not necessarily working in this engineering field. We have obtained support from the administration of Ohio State University to give this course, and are at present working out some of the details. The Air Force wants to send about 20 people, and are considering opening it up to people from the other services and from industry."

b. (1) There being no further comment, the acting Chairman then asked some of the distinguished guests of the conference for any general comment they might care to make, and called upon Dr. Leonard Mead, Tufts University.

(2) Dr. Mead recalled his experience with military human factors engineering problems since the Monday morning on December 8, 1941, when the beginning of his planned research at Fort Monroe on certain Army range-finder problems was interrupted because the equipment had to be shipped to theaters where it could be put to operational use. He pointed out that, although psychologists have often been involved in human factors engineering by default, this is to a degree an improper utilization of manpower, since engineers are unquestionably better engineers than psychologists are. He therefore ventured two predictions: (a) that suitably trained engineers will gradually take over the applications function in this field; and (b) that the biological scientists will thus be freed to prosecute research to uncover the basic data for such applications.

(3) The Acting Chairman, in thanking Dr. Mead, concurred heartily in his views. He noted that the excellent presentations made at the conference by the CONARC Boards might lead some to the superficial view that the design errors noted were the result of ineptitude or ignorance on the part of design engineers. In fact, however, more usually these design inadequacies are the result of compromises which the design engineer has had reluctantly to make; and he knows as well as we who "second guess" him that his solution is less than perfect. In a very important sense, the job of human factors research often reduces to the finding of ever more suitable grounds on which to effect such compromises.

c. Acting Chairman:

"On behalf of General Conway, and I am sure that each of you joins in this expression, it is important now to express gratitude to General Ryan and Col Frankel, and to our hosts here at AMRL, for having provided so graciously for our convenience and comfort at this conference. These thanks, of course, we know are also due to Col Gersoni and Dr. Sperling, of the Office of the Surgeon General, for their thoughtful advance planning for the Conference, and to Lt Col Joseph R. Blair, Dr. O'Dell, and Capt Hartman for their splendid scheduling and execution of those plans. In addition I am sure that each of you would wish me to record here your personal and direct thanks to Capt J. L. Fletcher and his assistants, Mrs. Sue Ball and Pvt Jack Snyder, who served so helpfully as registrars; to Capt Huckabey and Mrs. Noland, who patiently handled all of the vagaries of the multitude of our separate travel arrangements, and to Sgt Kling, Pfc. Roadman, and SP/3 Nygaard who operated our on-post transportation; to Pfc. Young, our Projectionist; and to Sgt. Shepard, who took our photograph but cannot be held accountable for our appearance. If Gen Conway had been able to be here this morning he would also wish to thank Lt Polidora, who served as aide during the conference to him and to Dr. Rollefson; and all of you have excellent reason to thank the Visitors Bureau of this Armor Center for the housing arrangements they have provided. Last, but by no means least, we all thank the entire staff of the Psychology Department of the Army Medical Research Center for providing the laboratory visits and demonstrations which were an outstanding feature of an entirely splendid conference."

d. The Conference adjourned at 1055 hours on 9 November 1956.

APPENDIX 1
ROSTER OF CONFEREES

TABLE OF CONTENTS

A. ALPHABETIC ROSTER OF CONFEREES AND GUESTS

NAME	ORGANIZATION
ALLEN, Col W. A.	Chemical Corps Engineering Command Army Chemical Center, Maryland
BAILEY, Dr. John W.	Transportation Corps Research & Engineering Command Fort Eustis, Virginia
BAKER, Dr. Lynn E.	Office, Chief of R & D, Dept of the Army Washington, D. C.
BARRON, Lt Col Robert D.	Canadian Medical Liaison, OTSG Washington, D. C.
BATES, Col Raymond H.	CONARC Board Nr. 5 Fort Bragg, North Carolina
BENNETT, Mr. H. B., Sr.	Engineer R & D Laboratories Fort Belvoir, Virginia
BENSON, Mr. Willard R.	Picatinny Arsenal Dover, New Jersey
BLAIR, Lt Col Joseph R.	Army Medical Research Laboratory Fort Knox, Kentucky
BLAIR, Dr. Wesley C.	Ordnance Human Engineering Laboratory Aberdeen Proving Ground, Maryland
BLAU, Dr. Ben Ami	Ordnance Human Engineering Laboratory Aberdeen Proving Ground, Maryland
BROMILEY, Dr. R. B.	Defense Research Medical Laboratories Toronto, Ontario, Canada
CAPASSO, Mr. Nicholas S.	Office of the Chief Chemical Officer Washington, D. C.
CARNEY, Mr. William	Ordnance Tank-Automotive Command Center Line, Michigan
CHEATHAM, Dr. Paul G.	Office of Naval Research Washington, D. C.
CHRISTENSEN, Mr. Julien M.	Aero Medical Laboratory Wright-Patterson AFB, Ohio
CONWAY, Brig Gen Theodore J.	Office, Chief of R&D, Dept of the Army Washington, D. C.
CRAWFORD, Dr. Meredith P.	Human Resources Research Office Washington, D. C.
CRITES, Mr. Barry D.	Rock Island Arsenal Rock Island, Illinois
CRUSE, Mr. Charles S.	Ordnance Human Engineering Laboratory Aberdeen Proving Ground, Maryland
DAVIS, Dr. Thomas R. A.	Army Medical Research Laboratory Fort Knox, Kentucky

DeTOGNI, Mr. G. R.	Watervliet Arsenal Watervliet, New York
DUSEK, Dr. E. Ralph	Quartermaster R & D Command Natick, Massachusetts
FARBER, Maj L. J.	CONARC Fort Monroe, Virginia
FILIPPI, Dr. Michael J.	O Asst Cml O for Plans & Doctrine Washington, D. C.
FISCHLE, Capt Edward J.	CONARC Board Nr. 4 Fort Bliss, Texas
FISH, Mr. Stanley W.	Springfield Armory Springfield, Massachusetts
FITTS, Dr. Paul M.	Ohio State University Columbus, Ohio
GALE, Mr. Manfred	Engineer R & D Laboratories Fort Belvoir, Virginia
GEORGE, Major C. C.	CONARC Board Nr. 6 Fort Rucker, Alabama
GERSONI, Col Charles S.	Office of The Surgeon General, DA Washington, D. C.
GILLEN, Capt Frederick R.	Hq Air R&D Command Baltimore, Maryland
GOLDSMITH, Mr. C. Thomas	Picatinny Arsenal Dover, New Jersey
GRAHAM, Mr. Donald I., Jr.	Redstone Arsenal Huntsville, Alabama
GRIFFITH, Mr. Paul E.	Signal Corps Engineering Laboratories Fort Monmouth, New Jersey
HAGGARD, Dr. Donald F.	Quartermaster R&D Command Natick, Massachusetts
HARLOW, Dr. Harry F.	University of Wisconsin Madison, Wisconsin
HANSEN, Mr. Alfred A. E.	Ordnance Tank-Automotive Command Center Line, Michigan
HARPER, Mr. W. R.	Canadian Joint Staff Washington, D. C.
HARRIS, Dr. Frank J.	The Johns Hopkins University ORO Washington, D. C.
HEMBREE, Dr. Howard W.	QM Field Evaluation Agency Fort Lee, Virginia
HICKS, Col Herbert C., Jr.	Office, Chief of R&D, Dept of the Army Washington, D. C.
HOWLAND, Dr. Daniel	Ohio State University Columbus, Ohio

HOYT, Dr. Ruth	Defense Research Board of Canada Ottawa, Ontario, Canada
HUGHES, Mr. Thomas D.	Watertown Arsenal Watertown, Massachusetts
HULLINGHORST, Col Robert L.	Office of The Surgeon General, DA Washington, D. C.
IRELAND, Dr. Richard M.	Signal Corps Engineering Laboratories Fort Monmouth, New Jersey
JAMIESON, Mr. A. L.	Frankford Arsenal Philadelphia, Pennsylvania
KAUFMAN, Mr. Joseph	Office of Chief of Ordnance Washington, D. C.
LORENZEN, Mr. Theodore G., Jr.	Ordnance Weapons Command Rock Island, Illinois
McCAIN, Mr. Claude N.	Ordnance Human Engineering Laboratory Aberdeen Proving Ground, Maryland
McCONNELL, Col C. W.	Hq CONARC Fort Monroe, Virginia
MEAD, Dr. Leonard C.	Tufts University Medford, Massachusetts
MILLARD, Maj Alfred J.	CONARC Board Nr. 3 Fort Benning, Georgia
MONTAGUE, Lt Col Ernest K.	Office of The Surgeon General, DA Washington, D. C.
MORGAN, Mr. Irving B.	O Dep C Cml O for Scientific Activities Washington, D. C.
NADEL, Dr. Aaron B.	Office Asst Sec Def (R&D) Washington, D. C.
NOLAND, Dr. Carson Y.	Human Research Unit Nr. 1 (CONARC) Fort Knox, Kentucky
ODELL, Dr. Floyd A.	Army Medical Research Laboratory Fort Knox, Kentucky
PAGE, Dr. Howard E.	Office of Naval Research Washington, D. C.
PETERS, Mr. George A.	Picatinny Arsenal Dover, New Jersey
REGAN, Mr. James J.	US Naval Training Device Center Port Washington, New York
REVESMAN, Dr. Stanley L.	Ordnance Human Engineering Laboratory Aberdeen Proving Ground, Maryland
ROBERTSON, Capt Bruce H.	CONARC Board Nr. 2 Fort Knox, Kentucky
ROLLEFSON, Dr. Ragnar O.	Office Chief of R&D, Dept of the Army Washington, D. C.

RUBIN, Dr. Leonard S.	Chemical Warfare Laboratories Army Chemical Center, Maryland
SPERLING, Dr. Philip I.	Office of The Surgeon General, DA Washington, D. C.
STOLARZ, Mr. Theodore J.	Frankford Arsenal Philadelphia, Pennsylvania
SWAFFORD, Lt Col Paul C.	CONARC Board Nr. 1 Fort Sill, Oklahoma
SWANSON, Mr. Leonard S.	Rock Island Arsenal Rock Island, Illinois
UHLANER, Dr. Julius E.	The Adjutant General's Office Washington, D. C.
VALLANCE, Dr. T. R.	Human Research Unit Nr. 1 (CONARC) Fort Knox, Kentucky
VINEBERG, Dr. Robert	Human Resources Research Office Washington, D. C.
VINING, Mr. T. M.	Chemical Corps Engineering Command Army Chemical Center, Maryland
WALKER, Dr. Robert Y.	Army Medical Research Laboratory Fort Knox, Kentucky
WHILLANS, Dr. Morley G.	Defence Research Board of Canada Toronto, Ontario, Canada
WHIPPLE, Dr. James E.	Human Resources Research Office Washington, D. C.
WING, 1st Lt Lubert	CONARC Board Nr. 3 Fort Benning, Georgia

B. ROSTERS OF MEMBERS AND REPRESENTATION ON WORKING GROUPS.

(1) WORKING GROUP A

Joint Services Steering Committee on the Human Engineering Guide for Design Engineers

NAME	ORGANIZATION
BAKER, Dr. Lynn E. (Chmn)	Human Factors Research Div, OCRD, D/A.
BAILEY, Dr. John W.	Trans. Corps Rsch & Engr Comm, Ft. Eustis, Va.
BROMELEY, Dr. R. B.	Defense Rsch Med. Labs., Toronto, Ont., Canada
BENNETT, Mr. H. B.	Engr R&D Lab., Ft. Belvoir, Va.
BLAU, Dr. Ben Ami	Ord. Hum. Engr Lab., Aberdeen Prvg Gd, Md.
CAPASSO, Mr. Nicholas S.	Off. of the Ch., Cml Off., Washington, D. C.
CHEATHAM, Dr. Paul G.	ONR, Washington, D. C.
CHRISTENSEN, Mr. Julien M.	Aero-Med Lab., Wright-Patterson AFB, Ohio
GOLDSMITH, Mr. C. Thomas	Picatinny Arsenal
GRAHAM, Mr. Donald I.	Redstone Arsenal
GRIFFITH, Mr. P. F.	Signal Corps Engr Lab., Ft. Monmouth, N. J.
HAGGARD, Dr. Donald F.	QM R&D Comd, Natick, Mass.
HEMBREE, Dr. Howard	Field Eval. Agency, Ft. Lee, Va.
NADEL, Dr. Aaron B.	OASD(R&D), Washington, D. C.
REVESMAN, Dr. Stanley	Ord. Hum. Engr Lab., Aberdeen Prvg Gd, Md.
RUBIN, Dr. L. S.	Cml Warfare Lab., Army Cml Ctr., Md.
SPERLING, Dr. Philip	OTSG, Washington, D. C.
SWAFFORD, Lt Col Paul C.	CONARC Bd Nr. 1, Ft. Sill, Okla.
VINEBERG, Dr. Robert	HumRRO, Washington, D. C.
VINING, Mr. T. M.	Cml Corps Engr Comd, Army Cml Ctr, Md.

(2) WORKING GROUP B

Training of Army Officers in Engineering Psychology

NAME	ORGANIZATION
HICKS, Col Herbert C. (Chmn)	Human Factors Research Div, OCRD, D/A
ALLEN, Col W. A.	Cml Corps Engr Comd, Army Cml Ctr, Md.
BATES, Col R. H.	CONARC Bd Nr. 5, Ft. Bragg, N. C.
BENSON, Mr. Willard R.	Picatinny Arsenal
CAPASSO, Mr. M. S.	Hq, R&D Comd, Cml Corps, Washington, D. C.
COUSINEAU, Mr. Edward	Springfield Armory
CRUSE, Mr. Charles S.	Ord. Hum. Engr Lab., Aberdeen Prvg Gd, Md.
DeTOGNI, Mr. G. R.	Watervliet Arsenal
FISCHLE, Capt Edward J.	CONARC Bd Nr. 4, Ft. Bliss, Texas
GERSONI, Col Charles S.	OTSG, Washington, D. C.
FILIPPI, Dr. Michael J.	HCCmlO/P&D, OCCmlO, Washington, D. C.
HANSEN, Mr. Alfred A. E.	Detroit Arsenal
HARRIS, Dr. Frank J.	Johns Hopkins Univ., ORO, Washington, D. C.
JAMIESON, Mr. A. L.	Frankford Arsenal
LORENZEN, Mr. Theodore G. Jr.	Ord. Weapons Cmd, Rock Is. Arsenal
McCONNELL, Col C. W.	CONARC, Ft. Monroe, Va.
MEAD, Mr. Leonard C.	Tufts University
MONTAGUE, Lt Col F. K.	OTSG, Washington, D. C.
MORGAN, Mr. I. B.	OCCmlO, Washington, D. C.
PAGE, Mr. Howard E.	Office of Naval Research
SWANSON, Mr. Leonard S.	Rock Island Arsenal, Ill.
WHIPPLE, Dr. James E.	HRU Nr. 4, Ft. Bliss, Texas
WING, Lt Lubert	CONARC Bd Nr. 3

(3) WORKING GROUP C

Human Factors in Design of Equipment for use in Arctic Climates

NAME	ORGANIZATION
DUSEK, Dr. E. Ralph (Chmn)	QM R&D Comd, Natick, Mass.
BENSON, Mr. Willard R.	Picatinny Arsenal, Dover, N. J.
BLAIR, Dr. Wesley	Ord. Hum. Engr Lab., Aberdeen Prvg Gd, Md.
CARNEY, Mr. William	Ord. Tank-Automotive Comd, Center Line, Mich.
CRAWFORD, Dr. Meredith P.	HumRRO, Washington, D. C.
CRITES, Mr. Barry D.	Rock Island Arsenal, Ill.
DAVIS, Mr. Thomas	AMRL, Ft. Knox, Ky.
FARBER, Maj L. J.	CONARC, Ft. Monroe, Va.
FISH, Mr. Stanley W.	Springfield Armory, Mass.
GALE, Mr. Manfred	Engr R&D Lab., Ft. Belvoir, Va.
HARPER, Mr. W. R.	Canadian Joint Staff, Washington, D. C.
HUGHES, Mr. Thomas D.	Watertown Arsenal, Mass.
IRELAND, Dr. Richard M.	SCEL, Ft. Monmouth, N. J.
KRAEMER, Mr. Alfred I.	HumRRO Unit Nr. 1, Ft. Knox, Ky.
McCAIN, Mr. Claude N.	Ord. Hum. Engr Lab., Aberdeen Prvg Gd, Md.
MILLARD, Maj Alfred L.	CONARC Bd Nr. 3, Ft. Benning, Ga.
MORGAN, Mr. Irving B.	ODCCmlO (Sci. Activities), Washington, D. C.
PETERS, Mr. George A.	Picatinny Arsenal, Dover, N. J.
ROBERTSON, Capt Bruce H.	CONARC Bd Nr. 2, Ft. Knox, Ky.
SWANSON, Mr. Leonard S.	Rock Island Arsenal, Ill.
UHLANER, Dr. Julius E.	TAGO, Washington, D. C.

APPENDIX 2

CONFERENCE REFERENCE MATERIALS

TABLE OF CONTENTS

1. ORDNANCE CORPS

Human Engineering Activities

Prepared for 2d Annual Army Engineering Psychology
Conference - 7-9 November 1956

I. Human Engineering Laboratory, Aberdeen Proving Ground, Maryland

a. Organization Chart.

b. Projects Completed Since Last Army Engineering Psychology Conference.

c. List of Professional Personnel.

d. List of Current Tasks.

e. Classified Supplement (CONFIDENTIAL) supplied, as appropriate, on request to Human Factors Research Division, OCR&D, D/A, Washington, D. C.

II. Ordnance Tank-Automotive Command, Detroit Arsenal, Center Line, Michigan

a. Bibliography of Human Engineering Studies completed since last conference.

b. List of Human Engineering Professional Staff.

c. List of Current Tasks.

III. Rock Island Arsenal, Rock Island, Illinois

a. Organization of Human Engineering at Rock Island Arsenal.

b. Studies completed since last Conference.

c. Human Engineering Staff.

d. List of Current Tasks.

IV. Ordnance Weapons Command, Rock Island, Illinois

a. Task completed since last Conference.

b. Human Engineering Staff.

c. Current Tasks.

V. Frankford Arsenal

a. Tasks completed since last Conference.

b. Human Engineering Staff.

c. Current Tasks.

VI. Springfield Armory

a. Task completed since last Conference.

b. List of Professional Staff.

c. Current Task.

VII. Picatinny Arsenal

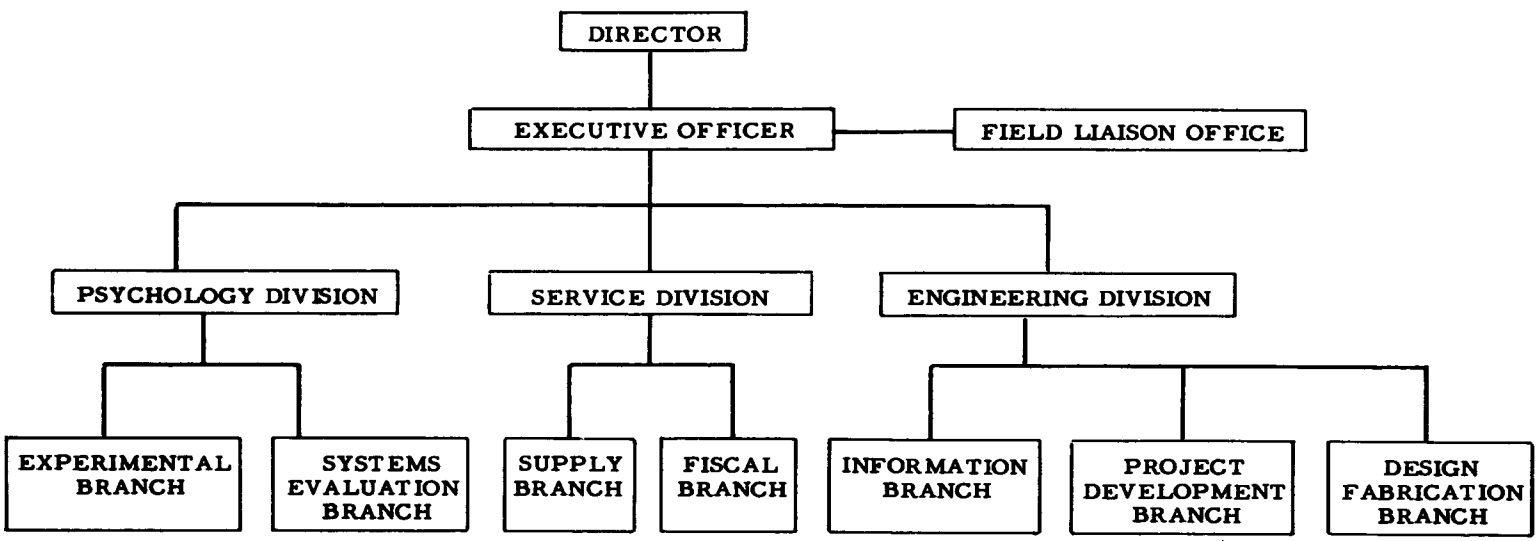
a. Organization Chart.

b. Bibliography of Reports Published since last Conference.

c. Classified Supplement (CONFIDENTIAL) supplied, as appropriate, on request to Human Factors Research Division, OCRD, D/A, Washington, D. C.

VIII. Watervliet Arsenal

ORGANIZATION OF HUMAN ENGINEERING LABORATORY
ABERDEEN PROVING GROUND, MARYLAND



I. HUMAN ENGINEERING LABORATORY, ABERDEEN PROVING GROUND, MD.

b. Projects Completed Since Last Army Engineering Psychology Conference.

TM #14 (U)	Measurement of Temperatures in Various Ordnance Equipment under the Desert Environment, 17 February 1956, by Stanley L. Revesman and Frederick W. Schulze
TM #15 (C)	Human Engineering Survey of NIKE Field Installations, 14 February 1956, by Richard C. Kaehler, et al
TM #16 (U)	Human Engineering Survey of M-48 Tank, 7 March 1956, by Evan Charney, et al
TM #17-1 (S)	Psychological and Physiological Effects of Muzzle and Breech Blast, 4 May 1956, by Wesley C. Blair and Frederick W. Schulze
TM #18 (C)	Human Engineering Evaluation of the Mock-Up Equipment of the LACROSSE B Forward Guidance Station, by Stanley L. Revesman et al
TM #19 (U)	Human Engineering Arctic Field Liaison Study, 23 April 56, by Evan Charney, et al
TM #20 (U)	Visual Efficiency Under Desert Conditions, by Leon T. Katchmar, et al
TM #21 (U)	Human Engineering Evaluation of Truck, 1/4 Ton, 4 X 4, XM151, 20 June 1956, by Edward C. Weiss and SP3 Arthur L. Taylor
TM #22 (C)	Minimum Cubic Dimensions for Operators of an Integrated Fire Control System, 8 August 1956, by Helen W. Nelson and John E. Leopardo
TM #23 (U)	Effectiveness of Warning Lights as a Function of Flash Rate, 15 August 1956, by Leon T. Katchmar and Nathan H. Azrin
TM #24	Human Engineering Survey of Honest John Weapons System, 17 September 1956, by Alfred P. Van Huyck, et al
TM #25 (U)	The Effects of Modified M1 Rifle Sights on Marksmanship at Low Levels of Illumination, 28 August 1956, by David C. Hodge

NOTE: Four (4) additional projects have been completed and will be published in the near future.

c. List of Professional Personnel

Psychology Personnel

Dr. Ben Ami Blau
Dr. John D. Weisz
Dr. Leon T. Katchmar
Dr. Stanley L. Revesman
Dr. Edward C. Weiss
Dr. Wesley C. Blair
Mr. Martin I. Kurke
Mr. Lewis Estrine
2d Lt. James H. Koplin
2d Lt. Dwight K. Andrew
2d Lt. Alfred P. Van Huyck
Mrs. Lois F. Mack
Pfc Harry F. Pohlmann
Pvt Nathan H. Azrin
Pfc Robert B. Bell
Pvt Albert S. Bacon
Pfc Theodore W. Miller

Engineering Personnel

Mr. Charles S. Cruse
Mr. Robert E. Jelinek
Mr. John A. Stephens
Mr. James I. Randall
Mr. Lawrence E. Deering
Mr. Claude N. McCain, Jr.
Mr. Calvin G. Moler
Mr. Ray Donley
Mr. Raymond F. Blackmer
Capt. Cecil W. Muller
SP3 Anthony J. Rose
SP3 Charles B. Lansill
Pfc John E. Leopardo
Pfc Robert Fahrenthold
Pfc Albert C. Notary
Pvt Bruno L. Sova

d. List of Current Tasks.

1. R&D on Steering Control Devices Employed in Track-Laying Vehicles (TB1-1000-3)

This is a laboratory study in which a driving simulator was constructed. This will be used to evaluate driving performance of military personnel using five types of steering controls. The ultimate goal of this project is to determine the optimum type of steering control for track laying vehicles.

The simulation equipment has been completed, including engineering check out. A task film is now being prepared and when this is complete, the testing of subjects will begin.

2. Driver's Position in Tanks (TB1-1000-7)

The purpose of this field study is to evaluate driving performance of military personnel of track laying vehicles while in an

atypical driving position against similar performance in the conventional seated position.

The first draft of the final report on this project has been completed. The finished report should be ready for publication in the near future. In general it was found that a tracked vehicle could be driven from a prone driving position for relatively long periods of time without great difficulty. However, due to the physical and mechanical conditions inherent in the equipment, some difficulty was experienced in vision and general operator comfort.

3. System Evaluation of the Tank, 76mm Gun M41A1 (TB1-1000-12)

The evaluation of this weapon system has two major purposes. (1) The human factors in the operation and design of the M41A1 tank are evaluated by describing a population of missions and conditions, analyzing the system's limitations, functions, and describing the effect of the limitations upon the functioning of the system. Design criteria of value to arsenal engineers resulted from the intensive study of the man-machine relationship of the M41A1. (2) A methodology is developed by which the human factors of an Ordnance weapon system may be evaluated in order to determine the compatibility of design to expected operations while the equipment is still in the preproductive stage of development. A detailed study was made of many accurately simulated tactical situations in order to evaluate the man-machine aspects of the M41A1. The methods and procedures used constitute a system of evaluation which can be used with great effectiveness on similar items of Ordnance equipment.

4. Psychological and Physiological Effects of Muzzle and Breech Blast (TB1-1000-18)

In brief the program will attempt to determine the effects of blast on various types of performance. This will require establishment of lethality limits and because of the obvious hazards involved, the research program will be initiated on an animal level. The use of animals such as Rhesus monkeys and chimpanzees in the shock tube installation at Aberdeen Proving Ground will allow well controlled studies in the field of blast in which such important variables as peak pressures, durations, repeated exposures, etc., can be reproduced and their contributing effects on performance accurately ascertained. When the relationship between various blast components and performance has been established with regard to primates, it will be possible to utilize this information in determining the critical limits for humans. A coordinated effort on the part of the Ballistic Research Laboratories, the Chemical Corps Medical Laboratories and the Human Engineering Laboratory will result in the correlation of the physiological effects of blast in an objective manner.

The blast program, in its totality should yield the following kinds of information, with regard to Rhesus monkeys:

(a) What are the fatality limits of blast with regard to pressure/time relationships?

(b) What are the physiological effects of fatal and near fatal blasts?

(c) What behavioral changes are concomitant with blast levels found around Ordnance weapons?

(d) What relationship exists between behavioral changes due to blast and concomitant physiological changes?

This information can be applied to the human level either through further experimentation or through extrapolation.

A first draft of an interim report covering the development of the rigid-mount chairs and the results of all exposures made in them was begun. It will be completed and published in October. The training of the animals in the Wisconsin General Test Apparatus has begun. Training on the battery of tests proper will begin shortly.

5. Physical Force Problems: I. Cranking Rate Under Various Torque Loads (TB1-1000-21)

The work on this project is being performed at the request of the Research and Development Division at Rock Island Arsenal.

The primary purpose of this research is to determine the amount of work which a man can expend as a function of (a) size, shape and position of various control devices such as hand cranks, hand wheels and hand levers, and (b) the resistant load against which these control devices must be operated.

The studies are oriented toward providing answers to the following questions:

(a) What is the amount of work in foot pounds that a man can perform in turning a hand wheel or hand crank?

(b) What is the amount of work in foot pounds that a man can perform in pumping a hand lever?

The major variables which are being considered are:

(a) Hand wheel and hand crank diameter and length of lever handle.

(b) Resistant torque loads applied to hand wheels, cranks, and levers.

(c) Speed of rotation of hand wheels and cranks and speed of pumping of levers.

(d) Length of time of work.

The answers derived from this work will find application in the design of gun mounts, rocket launchers, etc., by allowing design engineers to know beforehand the amount of work which a man can be expected to perform.

6. The Effects of Modified M1 Rifle Sights on Marksmanship at Low Levels of Illumination (TB 1-1000-22)

The purpose of this study is to specify those variables related to aiming and sighting on targets under low levels of illumination. The initial phase evaluated a series of experimental sights against the present M1 rifle sights with respect to consistency and accuracy of sight picture. For this purpose, a modified Winter sight simulator was used.

The first phase has been completed and three (3) of the test sights proved significantly better. These three (3) experimental sights will be further checked through actual firing range tests.

7. A Human Engineering Evaluation of the LACROSSE System (TB 1-1000-23)

The LACROSSE system is a surface to surface guided missile system. The details of this system are classified Confidential. The human engineering effort to date has been primarily concerned with the evaluation of a mock-up of one major component of the system. A mock-up of this component was evaluated in terms of:

(a) Reduction of operator error-likely situations encountered in the assembly of the unit, handling of the equipment related components, and possible user abuse of the equipment.

(b) The efficiency with which trained, representative operators could set up and use the unit.

(c) The environmental factors which might effect the efficiency of this unit of the system.

This evaluation of the mock-up has been completed and recommendations made as to methods of improving operator performance.

8. Study #2 - Torque Wrench Study

Purpose of study: To determine whether or not the use of the Torque wrench in the field is a valid requirement.

Scope: During the past quarter a study has been initiated to determine the ability of men to torque to required specifications with and without the aid of a torque wrench.

Data has been collected from 12 experienced Air Force mechanics, both civilian and military. The data is currently undergoing reduction.

These early results will indicate the future direction of this work.

9. Background Research in the Presentation of Radar Information

The purpose of this project is to investigate those variables, both psychological and/or electronic, which affect a radar operator's ability to: (a) detect targets, (b) interpret the potential threat of a target or targets, (c) designate a specific target in a multi-target display, and (d) maintain target contact under conditions of ground clutter and/or electronic jamming.

Some of the studies which will be initiated are:

a. Radar watch keeping as a function of the number of sense modalities simulated. This study is based on some of the work by Mackworth. The information to be gained from this work will be: (1) is target detection increased by stimulating more than one sense, i.e., visual-auditory-tactual, and (2) in a watch keeping situation where information is presented via more than one sensory mode, do subjects utilize both sensory channels or only one?

b. Effects of simultaneous auditory and visual stimulation on pip detection threshold. This study will attempt to determine whether the operator's ability to detect near threshold targets is enhanced by stimulating more than one sensory mode. Within this same area an attempt will be made to determine whether any benefits accrue during scope clutter or jamming conditions.

c. The relationship between scope size, sweep rate, and number of targets on detectability. At present, a state of confusion exists with respect to specifying the proper sweep speeds for certain types of radars. This study will attempt to determine the relationship between sweep speed and number of targets for various sized scopes.

d. Shape and color coding of targets for purpose of designation. This study will attempt to determine the functional relationship between shape and color coding of targets to decrease ambiguity in selecting and designating targets.

These studies are but an indication of the work which is being considered for this project area. It is to be understood that initial studies will guide the course of later studies so that advantage can be taken of accrued knowledge. The resultant information will be disseminated to design agencies so that it can be used to design more effective radar detection and acquisition systems.

10. Study #3 - Radar Symbol Evaluation

This study was initiated to evaluate the currently proposed HAWK system symbols with respect to their effectiveness in conveying certain categories of information. The basic question being asked is: "Does the meaning associated with a symbol in any way affect the recognition of that symbol in a tachistoscopic presentation?"

This study will provide information regarding the recognition thresholds of these symbols in addition to determining whether a particular symbol should be employed to designate a certain meaning such as a friendly target, enemy target, etc. At the present a tachistoscope is being built for this study and should be completed in the near future.

11. Phase II LAA Weapon (Towed Version)

The Laboratory was requested to prepare the human engineering requirements for inclusion in the MC's of this weapon system. The forming of these requirements will be the outgrowth of numerous information sources; Human Engineering Laboratory personnel experience with a similar integrated fire control system, literature surveys of similar systems and feasibility studies made by General Electric and Sperry Gyroscope Companies, and research conducted by this Laboratory, i.e., studies of noise levels of the Vulcan weapon.

Work now in progress:

a. Sound level studies on 20mm Vulcan; intensity level measurements and tape recordings have been made on special firings of the 20mm Vulcan. Octave band and spectrum analysis should be finished in the near future.

b. Study is continuing as required for preparing the human engineering requirements to be included in the military characteristics.

12. Missile Systems Contract Monitoring by the Human Engineering Laboratory

The efficiency of any missile system, regardless of type of design, is dependent to a large degree upon the ability of the using personnel to operate the equipment as the designers intended. This man-machine relationship has frequently been neglected in the past, primarily due to the fact that the necessity for such considerations was not urgent in the relatively simple systems then in use. In the extremely complex weapons systems now under development, this "human element" has become one of the most important factors in the design of the system. In order to render the full measure of effectiveness, the human engineering problems must be considered from the initial design concept.

To insure that these vital "human factors" are receiving the attention and design considerations merited by their importance, the Human Engineering Laboratory has been requested by Redstone Arsenal to monitor this aspect of missile development being accomplished by prime contractors.

Typical examples of this type are:

a. HAWK system
b. DART system
c. Redstone

It is anticipated that human engineering monitoring will become increasingly important as future missile systems are developed.

13. Troop Interview Program

The purpose of this program is to gather human engineering data pertinent to Ordnance materiel assigned to combat organizations. The data obtained through the interview program is evaluated by the Human Engineering Laboratory and reduced to design criteria which is disseminated to Ordnance manufacturing arsenals or other interested Department of Defense agencies.

Current field surveys include:

a. HONEST JOHN
b. 280mm Cannon
c. M59
d. CORPORAL II missile

II. ORDNANCE TANK-AUTOMOTIVE COMMAND, DETROIT ARSENAL, CENTER LINE, MICHIGAN

a. Bibliography of Human Engineering Studies Completed Since Last Conference.

1. The Human Engineering Specialist co-ordinates with various members of the Design, Engineering and Production Staffs to promote favorable conditions and determine practical limitations of factors pertaining to integration of physchophysiological requirements and anthropometric measures, promoting more favorable conditions for vehicle crews, greater reduction in size and weight of vehicles, and attaining optimum performance efficiency.

2. Conceived, designed, fabricated and tested a new Heating and Ventilating System, which proved a 400% improvement over Heating and Ventilating Systems used on tanks of the M48, M41E1 type. This system was tested at the Erie Ordnance Depot, Port Clinton, Ohio. (E.O.D. Special Test 49D, 8-246-361-68/A1-55, Project TT2-725, X.O. No. 1028, Serial No. 8564, 25 May - 10 November 1955).

3. Human Engineering Study of Rear View Mirrors by the University of Detroit, Detroit, Michigan, Contract DA-20-018-ORD-13724. Conceived design of "Indexing Spring Lock Washer" for positioning and retaining mirror brackets in optimum position. U.S. Patent applied for jointly by Ordnance Tank-Automotive Command and inventor, Alfred A. E. Hansen. Completed 30 September 1956. Tests conducted by Aberdeen Proving Ground and Ordnance Tank-Automotive Command.

4. M37-T161E3 Machine Guns. Comparative Monoxide Concentration Tests arranged by Project Engineer and conducted at Aberdeen Proving Ground.

5. Carbon Monoxide Test for Combat Vehicles and Evaluation of "Scrambler" Technique, Project TT1-696. Project modified, eliminating "Scrambler" technique. Recommended continuance of field tests.

6. U. S. Air Force Salvage Recovery Vehicle (Modified (T51). Engineering and Installation of Air Conditioning Unit in Driver's Cab. Contract DA-20-089-ORD-37598. Hondaille-Hershey Corporation, Highland Park, Michigan.

7. Experimental Prototype Air Conditioning Unit, Contract DA-20-089-ORD-36867. Scientific Products Company, Detroit, Michigan.

b. List of Human Engineering Professional Staff.

Mr. Alfred A. E. Hansen,
Human Engineering Specialist

c. List of Current Tasks.

1. Optimum Driver's Cockpit. G. O. Noville and Associates, Santa Monica, California, Contract DA-04-495-ORD-690. Project completed by 15 November 1956.

2. Turret Study, T95 Tank. Henry Dreyfuss, New York, N. Y., Contract DA-30-069-ORD-1151. Recommended discontinuance 12 September 1956 as study is duplicating work being done at this installation.

3. Seal Designs for Positive Pressure Systems on Combat Tanks. Project TT1-696. Seals being designed for use on T95 and T96 Tanks.

4. Human Engineering Survey and Analysis of Carrier, Cargo, Pneumatic Roller Type, XM 401, Project TT3-809. The Four Wheel Drive Auto Company, Clintonville, Wisconsin. Further surveys will be conducted during construction of mock-up and prototype.

5. Human Engineering Survey and Analysis of Carrier, Personnel, Full Track, Airborne, T113. Contract DA-04-200-ORD-536. Further surveys will be conducted during construction of mock-up and prototype.

III. ROCK ISLAND ARSENAL, ROCK ISLAND, ILLINOIS

a. Organization of Human Engineering at Rock Island Arsenal.

1-Psychologist
Human Engineer
Technical Service Section
Chairman

1-Supply Carriage Design Engineer
Artillery Section
Vice Chairman

1-Ord Design Engineer Artillery Section	1-Ord Design Engineer Rocket Launcher Section	1-Ord Design Engineer Special Equipment Section

b. Studies completed since last Conference.

1. "Relative Heat Conductivities of Coated and Uncoated Handwheels," Rock Island Arsenal Technical Report Nr 56-1284, dated 8 May 1956.

2. A written report containing recommendations relative to the Standardization of Numbers and Letters Study, which was conducted by the Industrial Division of this Arsenal, was submitted to that organization. Most of the comments and recommendations were incorporated in the feasibility report submitted to Office, Chief of Ordnance by the Industrial Division.

3. An on-going Human Engineering appraisal of the Honest John Improvement Program and the Little John System has been conducted during the design of the R&D materiel. This resulted in some human engineering recommendations being incorporated in said prototypes. A written Human Engineering Evaluation of both weapons will be published after the prototypes have been completed and tested.

4. Preliminary field human engineering testing of the Little John System has been conducted at Rock Island Arsenal.

5. A job analysis has been made of each crewman's task in the Little John System for the purpose of balancing work load in order to reduce emplacement and displacement time.

c. Human Engineering Staff.

Mr. Barry D. Crites,
M. A. in Psychology

d. List of Current Tasks.

1. Human Engineering evaluation of the XM386 System (Honest John Improvement Program). This will be accomplished by "expertizing" and observance of engineering field trials. The estimated completion date is 1 February 1957.

2. Human Engineering evaluation of the XM32 System (Little John). This will be accomplished by field trials conducted by the Rock Island Arsenal Human Engineer at White Sands Proving Ground. This study is expected to be complete on 15 December 1956.

3. A program of seminars on creative thinking for the benefit of the design engineers of this Branch is being developed by the Psychologist-Human Engineer. This program will begin on 1 November 1956 and continue indefinitely.

IV. ORDNANCE WEAPONS COMMAND, ROCK ISLAND, ILLINOIS

a. Task Completed Since Last Conference.

During February 1956, this Headquarters requested the Human Engineering Laboratory, Aberdeen Proving Ground, to conduct a short study to determine if it was feasible to consider using six (6) or eight (8) man crews to lift and carry materiel which would weigh approximately 700 to 900 pounds and to pull or push materiel which would weigh approximately 1500 pounds. Motion pictures were taken of six (6) and eight (8) man crews as they performed the tasks. These films and a report of the results of the test were discussed at a meeting at this Headquarters in March 1956. The results of the study were of considerable value to design engineers at Rock Island Arsenal who at that time were engaged in a critical development program.

b. Human Engineering Staff.

Mr. Theodore G. Lorenzen, Jr.,
Ordnance Engineer

c. Current Tasks.

1. This Headquarters has been assigned the responsibility for the development of the towed version of the Vigilante Weapons System. Due to the complexity of this system, major emphasis will be placed on the Human Engineering requirements. To date, the Human Engineering Laboratory has performed a research study under direction of ORDTR, on existing systems having similar characteristics in order to determine optimum design criteria for this development. Shortly after a contract is signed with a systems contractor, this Headquarters will hold a meeting to establish the channels of communication and the assistance to be given by each of the interested installations along Human Engineering lines. It is the intention of this Headquarters to have the Human Engineering Laboratory act in the capacity of consultant during the life of the project. Completion date for this project is calendar year 1959.

2. This Headquarters is also cooperating with the design engineers, from a Human Engineering standpoint, on the feasibility studies of a new major caliber artillery weapon. These studies will pertain mainly to the size of crew required for satisfactory operation of the gun.

V. FRANKFORT ARSENAL

a. Tasks Completed Since Last Conference.

1. Human Engineering comparison of three proposed fire control systems (Report R-1341).

2. A human engineering evaluation of the ONTOS weapon system (CONFIDENTIAL Report R-1329).

3. Some engineering psychology considerations in the design of an optical antiaircraft sight (CONFIDENTIAL Report R-1305).

4. Preliminary human engineering study of range finder, T47 (CONFIDENTIAL Report S-5253).

5. Preliminary report of a human engineering evaluation of Redstone Arsenal forward area weapon (S Report MR-626).

b. Human Engineering Staff.

Pvt T. J. Stolarz
Pvt D. F. Miller
SP3 J. F. Wing
Pfc R. V. Nunez
Miss T. J. Kita

c. Current Task.

Human Engineering for Ultimate BAT (continuing) which includes a comparison of the performance of sights of differing magnification and exit pupil diameter under low intensity.

VI. SPRINGFIELD ARMORY

a. Task Completed Since Last Conference.

The Effects of Rifle Recoil on marksmanship performance. - Contract DA-19-020-ORD-3461 by Ezra U. Saul and Jack Jaffe.

b. List of Professional Staff.

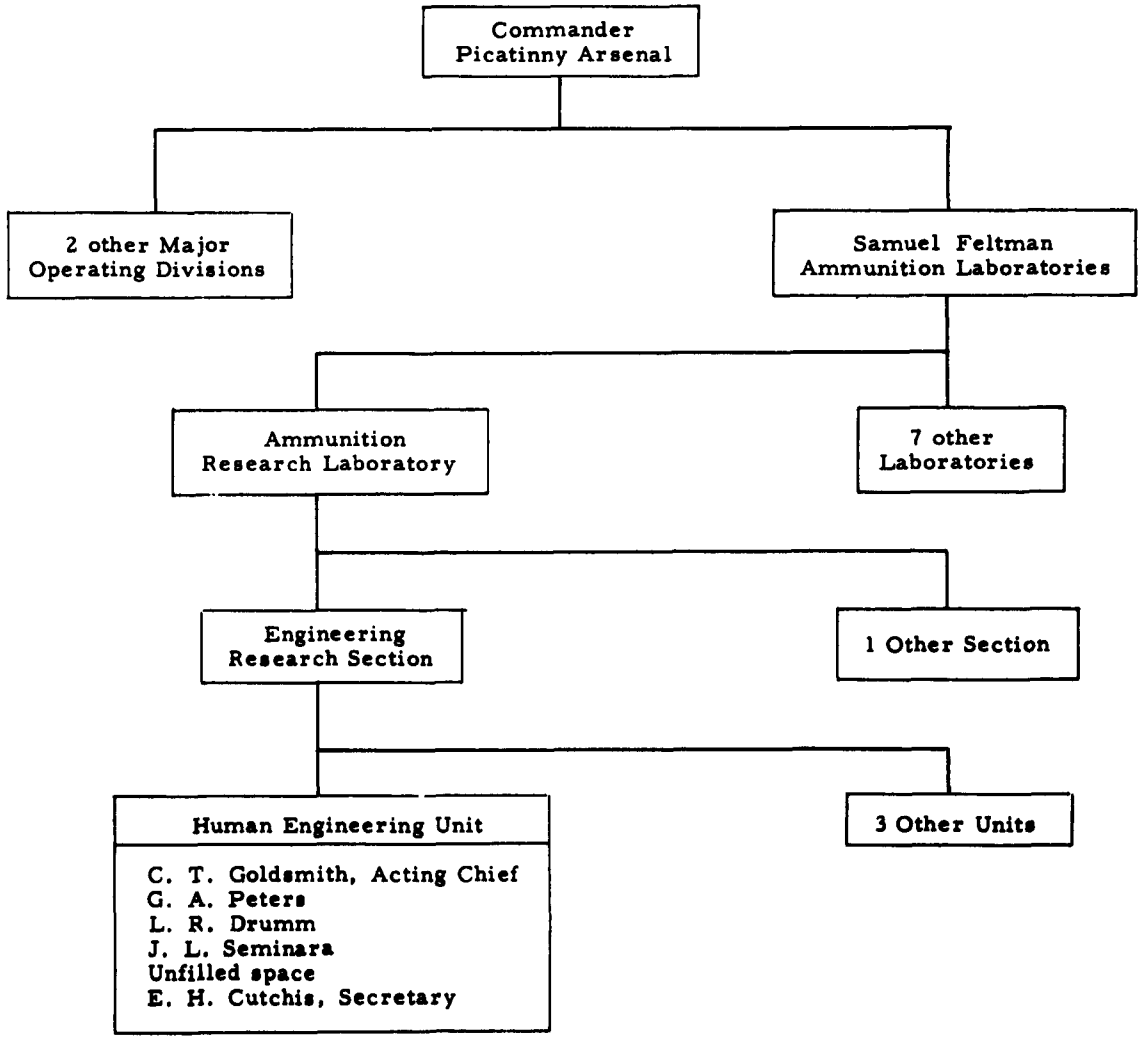
H. F. Hawthorne
S. W. Fish
E. F. Cousinau
A. J. Sonier
C. F. Packard

c. Current Task.

Contracts being prepared on R&D work on the Relationship of the target-sight-eye system for sighting rifles and sight mock-ups research on the relationship of sight line with the stock comb location for a rifle.

VII. PICATINNY ARSENAL

a. Organization and Personnel of Human Engineering Activity, Picatinny Arsenal.



VII. PICATINNY ARSENAL

b. Bibliography of Reports Published Since Last 14-15 Dec 55 Conference.

1. Human Engineering Recommendations for the design of a timing device, August 1956, PA Tech Rept No. 2339.

2. Human Engineering evaluation of opening devices for ammunition containers under Arctic conditions. Human Engineering Technical Memorandum No. 2, June 1956, PATR No. 2342, April 1956.

3. Ram Loading of Artillery ammunition by men I: Motion picture analysis, February 1956, HETM #3.

4. The T37 Mine: An analysis of arming operation, HETM #4, February 1956.

5. Human Engineering Recommendations for three-position fuze selector switches, HETM No. 5, March 1956.

6. Evaluation of a method for specifying barrier material cohesiveness, HETM No. 6, April 1956.

7. Preliminary anthropometric estimates of human surface area, June 1956, HETM #7.

8. Note on the portability of ammunition boxes, June 1956, HETM #8.

9. Probability of detection of antipersonnel mine trip wires, September 1956, HETM #9.

VIII. WATERVLIET ARSENAL

1. The Human Engineering Mission is a Section of the Research and Development Division as shown in figure 1.

2. Studies completed since the last conference:

a. Manual Operation of Cannon in an Arctic Environment.

b. Exercise Moosehorn User-Service Task.

c. Blast Effects of Automatic-aircraft Cannon - Phase I.

d. Pivot Chamber Gun Study - Phases a, b and c.

3. Watervliet Arsenal Human Engineering activity is being conducted by Mr. G. R. DeTogni.

4. Current Human Engineering Tasks:

a. Pivot Chamber Gun Feasibility Study.

(1) Estimated completion date: 1 November 1956.

(2) Approach: Study of human performance on a wooden mock-up of this weapon to determine probable cyclic rates, dexterity and energy requirements and safety conditions.

b. Blast Study for Automatic Aircraft Cannon.

(1) Estimated completion date: 1 April 1957.

(2) Approach: Literature search and proving ground test to determine blast values at the operator's position.

c. Winterization Studies.

(1) Estimated completion date: 1 May 1956.

(2) Approach: Literature search, liaison with Canadian human engineers, observation of winter cannon tests at Fort Churchill, recommendations to designers for improving human performance on cannon items.

R&D ORGANIZATION, WATERVLIET ARSENAL

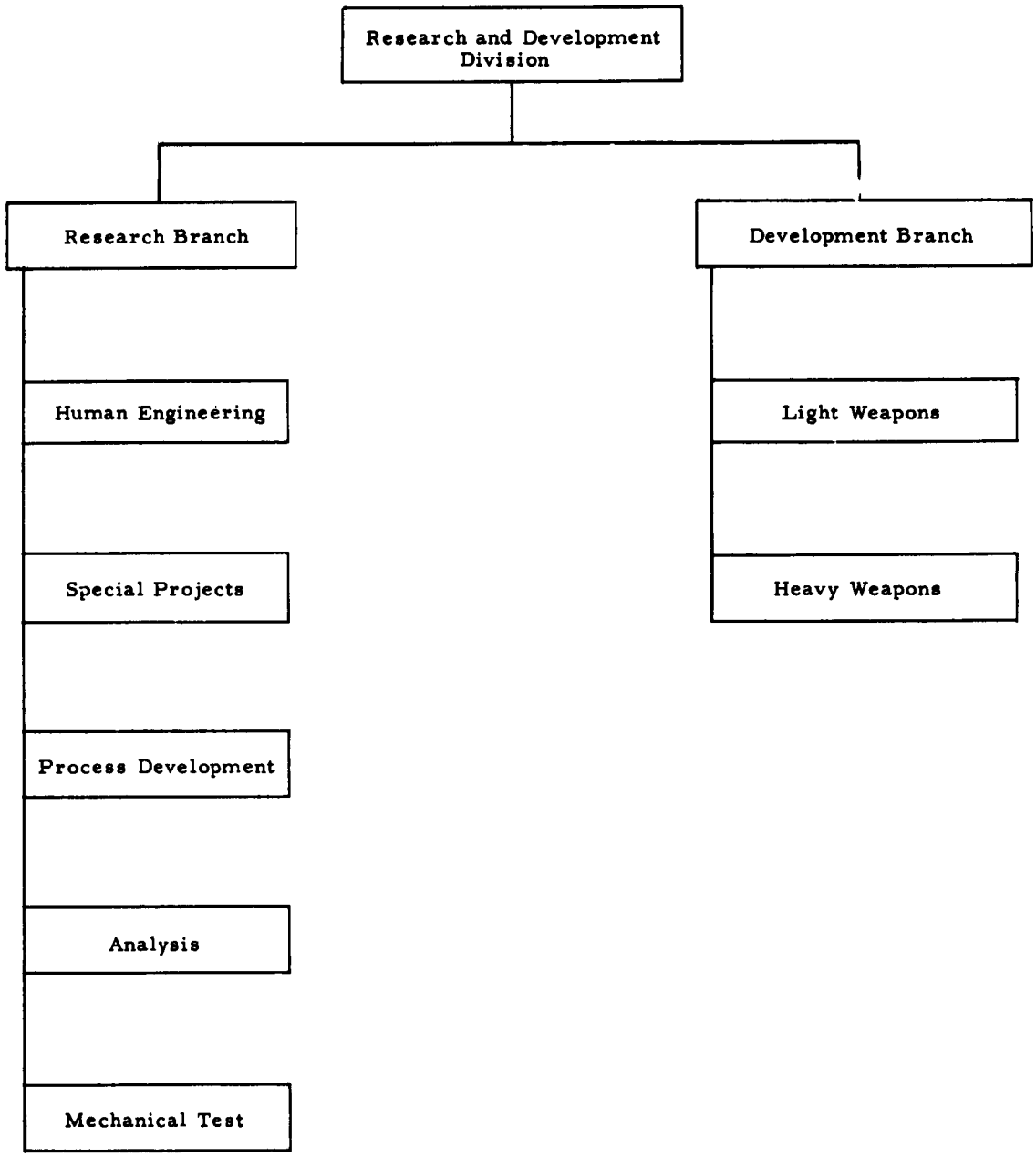


Figure 1

2. ARMY MEDICAL RESEARCH LABORATORY

Fort Knox, Kentucky

PSYCHOLOGY DEPARTMENT PROGRAM REVIEW

Prepared for

2nd Annual Army Engineering Psychology Conference

7 - 9 November 1956

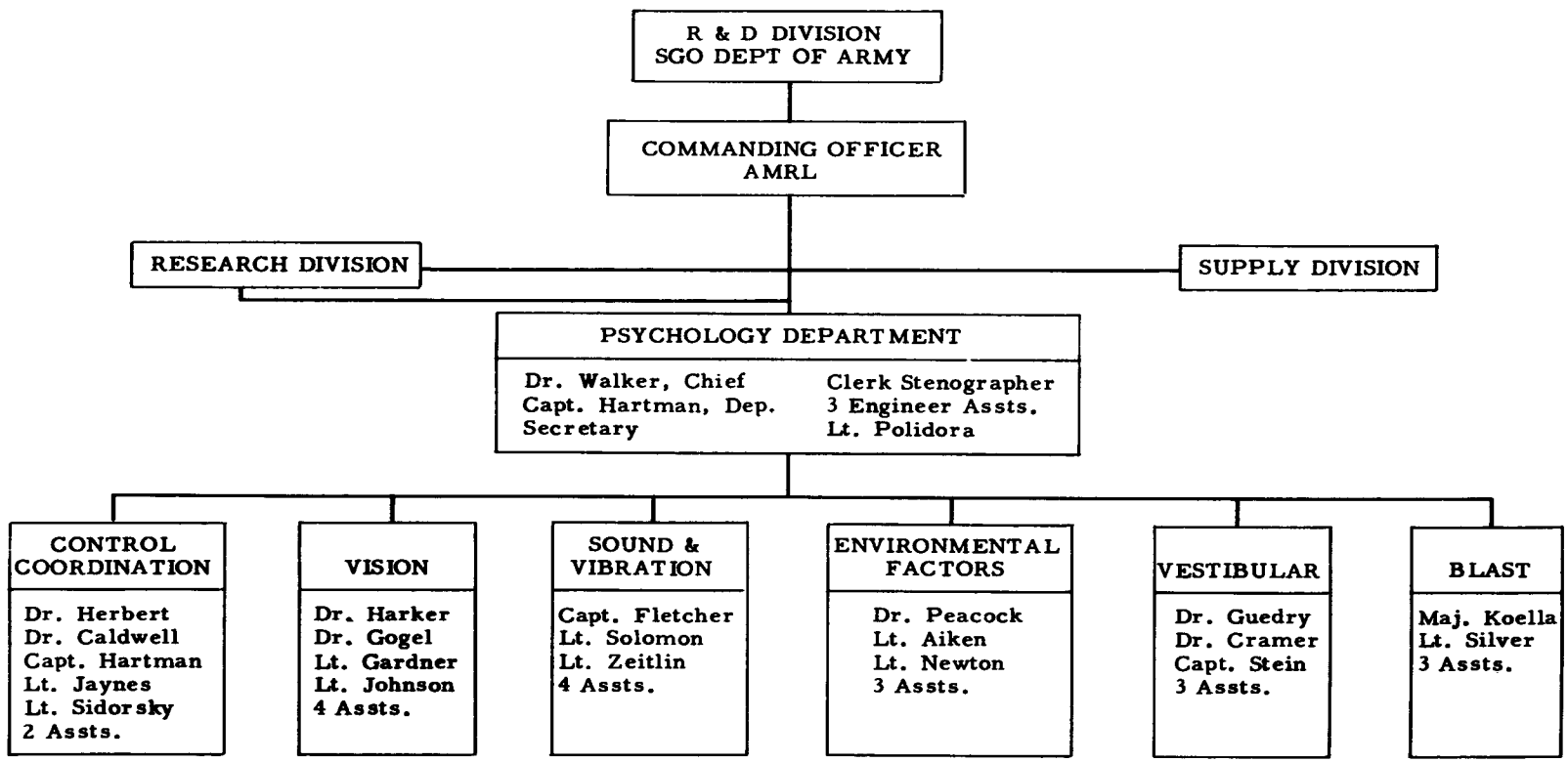
I Organizational Chart

II. Vita

III. Current Projects

IV. Published Reports

ARMY MEDICAL RESEARCH LABORATORY
PSYCHOLOGY DEPARTMENT
FORT KNOX, KENTUCKY



II. VITA

AIKEN, EDWIN G., Psychologist, 1st Lt., MSC
PhD, University of Illinois, 1954. Area of specialization: Learning and motivation.

CALDWELL, LEE S., Psychophysiologist, GS-11
PhD, University of Kentucky, 1955. Area of specialization: Biomechanics.

CRAMER, ROBERT L., Psychophysiologist, GS-12
PhD, University of Rochester, 1954. Area of specialization: Motion studies.

FLETCHER, JOHN L., Psychologist, Capt., MSC
PhD, University of Kentucky, 1955. Area of specialization: Audition and vision.

GARDNER, R. ALLEN, Psychophysiologist, 1st Lt., MSC
PhD, Northwestern University, 1954. Area of specialization: Vision.

GOGEL, WALTER C., Psychophysiologist, GS-12
PhD, University of Chicago, 1951. Area of specialization: Vision.

GUEDRY, FRED E., JR., Head, Motion Section, GS-12
PhD, Tulane University, 1953. Area of specialization: Motion studies.

HARKER, GEORGE S., Head, Vision Section, GS-12
PhD, State university of Iowa, 1950. Area of specialization: Vision.

HARTMAN, BRYCE O., Deputy Department Chief, Capt., MSC
PhD, Ohio State University, 1952. Area of Specialization: Motor skills.

HERBERT, MARVIN J., Head, Control Coordination Section, GS-12
PhD, University of Minnesota, 1953. Area of specialization: Motor skills.

JAYNES, WILLIAM, Psychologist, 1st Lt., MSC
PhD, Ohio State University, 1955. Area of specialization: Statistics.

JOHNSON, DAVID E., Optometrist, 2d Lt., MSC
BS, Ohio State University, 1954.

KOELLA, WERNER P., Head, Blast Section, Major, MC
MD, University of Zurich, Switzerland, 1942. Area of specialization: Neurophysiology.

NEWTON, JOHN M., Psychologist, 1st Lt., MSC
PhD, Ohio State University, 1955. Area of specialization: Physiological psychology.

PEACOCK, LELON J., Head, Environmental Factors Section, GS-11
PhD, University of Kentucky, 1956. Area of specialization: Physiological psychology.

POLIDORA, VINCENT J., Armor Officer, 2d Lt., Armor
MA, Ohio State University, 1955. Area of specialization: Motor skills.

SIDORSKY, RAYMOND, Psychologist, 1st Lt., MSC
PhD, Ohio State University, 1955. Area of specialization: Motor skills.

SILVER, Carl A., Psychologist, 1st Lt., MSC
PhD, Ohio State University, 1955. Area of specialization: Physiological psychology, audition, human engineering.

SOLOMON, LAWRENCE N., Psychologist, 1st Lt., MSC
PhD, University of Illinois, 1954. Area of specialization: Audition, clinical psychology.

STEIN, SAMUEL W., Internist, Capt., MC
MD, Harvard Medical School, 1954. Area of specialization: Internal medicine.

WALKER, ROBERT Y., Chief, Psychology Department, GS-15
PhD, State University of Iowa, 1933. Area of specialization: aviation psychology, perceptual and motor coordination, psychological interaction of operating environment and operator.

ZEITLIN, LAWRENCE R., Psychologist, 1st Lt., MSC
PhD, Northwestern University, 1954. Area of specialization: Motivation, perception, audition.

COLLINS, ROBERT D., Chief, Pathology Department, Capt., MC
MD, Vanderbi t University, 1951. Area of specialization: Pathology.

III. CURRENT PROJECTS

A. Control Coordination Section	Experimenter	Date Started	Estimated Completion Date
1. Driving Performance and Environmental Stress: Desert	Herbert Hartman Sidorsky	Jul 56	Dec 56

Trained army personnel drove 3/4 ton weapon carriers on a cross-country desert course. Subjects drove for 1, 4, 8 or 10-hour periods and were tested before, during and after the driving period for evidence of changes in skills important to vehicle manipulation.

Testing on the desert course was done only during the final hour of the subject's driving period. Periodic measures were made of the driver's ability to a) maintain a constant speed over a prescribed distance, b) come to a sudden stop (response time), c) maintain vigilance by responding to the appearance of a colored light either reflected in the rear-vision mirror or at a point 30^{o}, 60^{o}, or 90^{o} from line of vision to his right at head level, and d) a non-visual test which demands the full utilization of kinesthetic and auditory information available to the driver.

The pre- and post-driving test consisted of a battery of driver-performance tests which can be considered to be specific job-miniatures.

2. Control Position as a Factor in the Precise Manipulation of a Rotary Control	Sidorsky	Mar 56	Oct 56

Subjects performed a simple compensatory tracking task. Integrated-error scores were used to determine whether any significant differences in manipulation performance result as a function of the position of the control relative to the operator's body. A rotary control was placed at arm's length in any of 11 positions covering most of the area that a subject can reach comfortably in a seated position.

3. An Investigation of Handedness and Direction of Movement in Simple Continuous Tasks: I, Sine Sweep Inputs	Herbert Hartman Jaynes	Aug 56	Nov 56

Using a simple one dimensional sine sweep target input of 30 cpm pursuit tracking with a free-moving joystick, both left- and right-handed subjects track with the preferred and non-preferred hand. The design is a 2 x 2 matrix. A total of 20 subjects are being used: 10 right-handed and 10 left-handed men. Each subject serves as his own control. The basic data are graphic records of performance, using the graphic time-on-target technique.

4. Investigations of the Effect of Control Characteristics in Simple Tracking: I. Joystick Length	Hartman	Aug 56	Dec 56

In this experiment subjects track with a joystick having shaft length varying from 6 inches to 30 inches in 3 inch steps. Subjects are given one hour of training with each of the various lengths. Following this the test data are taken with all conditions in a single session. Analysis is made of the results of this final test session. Both cumulative time-on-target and hit scores, and graphic records of performance are obtained. Results will be summarized in terms of an efficiency curve.

5. The Influence of Target Frequency Upon Compensatory Tracking Performance	Hartman	Jan 56	Sept 56

Simple tracking tasks can be divided into two gross classes: pursuit and compensatory. Major differences in the effects of selected experimental variables are obtained for these two classes. The effect of target frequency, which has been studied in pursuit tracking, was also investigated in compensatory tracking. Seven frequencies ranging from 5 cpm to 60 cpm will be used. A curve relating performance to frequency is being plotted. An attempt is being made to determine relative tracking efficiency as a function of frequency for the two classes of tracking.

6. A Biomechanical Analysis of "Force-Spaces"	Caldwell	Sep 56	Mar 57

A program for research in the area of biomechanics has developed from the concept of "force-spaces" as an important factor in the design and placement of hand and foot controls. This program stresses the dynamic rather than the static aspects of spatial responses. The following questions outline the initial efforts to be made in readjusting the "working-space" to conform to the "force-space":

a. To what extent does the position of hand and foot controls affect the maximum forces exertable on them?

b. How does the position of a control affect the time that maximum force can be applied to it?

c. How do certain seat characteristics affect the maximum force exertable on controls at various locations?

B. Vision Section

Title	Experimenter	Date Started	Estimated Completion Date
1. The Inter-Relation of Vernier and Stereoscopic Acuity in the Perception of the Relative Depth Position of Objects	Harker	Jun 55	Oct 56

The object of the study is to evaluate the proportional contribution of vernier alignment and binocular disparity as cues to the perception of the real depth position of a test object. The technique of study is to vary the slope of the surface upon which objects are presented and thus to control the vertical displacement of the horizontal edges in relation to the depth displacement of the vertical edges as the test object is moved in depth.

2. The Disturbance of the Monocular and Binocular Visual Function in the Presence of Random Disturbances in the Visual Field	Harker	Jul 54	Jun 57

This project was initiated as a field evaluation of the decrement in visual capacity introduced by atmospheric shimmer. The technique of study was to utilize non-systematic distortions generated in the visual field by atmospheric boil and measure its influence upon a monocular (vernier alignment) task and upon a binocular (stereoscopic ranging) task to evaluate differential effects upon these two functions of vision. Failure to demonstrate significant contributions of atmospheric boil as a disturbance in the field of view has indicated the need for controlled laboratory work.

3. The Influence of Lack of Collimation and Eyepiece Defocusing Upon Stereoscopic and Vernier Acuity in the Army Population	Harker Johnson	Mar 56	Mar 58

Data are being accumulated on one hundred and twenty Army personnel between the ages of 18 and 28 with uncorrected 20/20 vision in both eyes. Experimental conditions sample a range of forced vergence from four prism diopters of divergence to sixteen prism diopters of convergence. Eyepiece defocusing is sampled over a range from plus one lens diopter to minus three lens diopters.

4. Response of an Observer to a Uniformly illuminated, Unstructured, Visual Field	Harker	Apr 56	Sep 57

Circuits for the dimming of fluorescent lamps have been purchased and modified to permit their application to small tubes. Illumination seen by reflection from a partial reflector through viewing apertures in an opaque face mask will be matched to that incident upon the mask proper to eliminate the viewing aperture edge and produce a wide angle uniformly illuminated field of view. Observation by the subject of illuminated stimuli in his field of view will be possible through the partial reflector. The situation similated will be that of "White-out", "High Altitude Myopia", or the "Whiteside phenomena" of partially relaxed accommodation.

5. Determiners of Apparent Depth Generated by Binocular Disparity Cues	Gogel	Nov 55	Oct 56

The role of binocular disparity cues in the determination of perceived relative distances needs to be investigated before it is possible to estimate the importance of good binocular vision for the completion of specific tasks. The problem of this study is to consider factors which allow a binocular disparity to be perceived as a linear extent. In one experiment the hypothesis was investigated that the estimated size of the frontal aspect of objects could convert a binocular disparity distance to a perceived linear distance. In a second experiment the possibility of perceptually equating a stereopsis extent to a frontal extent was investigated in a situation in which distance cues other than binocular disparity were minimal. In a third experiment a test of the possible effect of convergence on this task was undertaken. It appears from these experiments that the perceptual interrelation of frontal and stereopsis extents is a factor in the perception of depth from stereoscopic cues.

6. The Perceptual Interrelation of Frontal and Stereopsis Extents in Visually Complex Situations	Gogel	Aug 56	Jan 57

In the experiments cited above, the experimental situations were visually restricted in order to specify the distance cues available to the observer. In the present study, some of the conclusions resulting from these experiments will be applied to more complex visual situations. For example, the perceptual interrelation of frontal and stereopsis extents will be investigated under conditions in which a variety of cues to absolute distance are present. The degree to which the conclusions from the previous study can predict the results from the present study will indicate the generality of these conclusions to more commonplace visual situations.

7. Perception of Continuous Fluctuating Stimuli	Gardner	May 56	Dec 57

The problem of reading a fluctuating meter-needle is being studied as the task of evaluating successive serial stimuli. The performance of subjects in evaluating such stimuli will initially be studied in the absence of scalar and spatial factors. Subsequent studies will combine this feature of human behavior with selected scalar and spatial arrangements.

C. Sound Section

Title	Experimenter	Date Started	Estimated Completion Date
1. Localization in the Sub-Arctic	Coleman Solomon	Jan 55	Sep 56

Subjects were asked to localize sound sources in depth and in plane under arctic conditions. Other phases of the project will be performed in temperate and desert climates.

2. A Survey of Hearing Loss In Armored Personnel	Fletcher Solomon	Jul 55	Sep 56

The hearing of 3827 armored personnel has been tested. Individual testing was done on 706 subjects, while 3121 subjects were tested by a group testing procedure. A hearing data sheet was filled out on each subject to get information relative to the age, branch of service, use of ear protection, past and present noise exposure, and medical history. The data were machine analyzed and hearing loss has been related to age, use of ear protection, noise exposure, and medical history.

3. Studies of Localization in Desert Climates	Solomon	Jan 56	Dec 56

This study will extend the arctic localization study by Coleman and Solomon, to desert climates.

4. Localization of Sounds in Depth	Fletcher	Jan 56	Nov 56

Cues to depth perception were investigated for pure tones, in a natural environment approximating that of a free field (Yuma Test Station, Arizona).

5. Optimum Display Dimensionality for a Single Information Source	Zeitlin	Sep 56	Dec 56

Although man's channel capacity for transmitting information is quite limited in a single stimulus dimension, an effective increase in capacity can be obtained by increasing the dimensionality of the stimulus even if all the dimensions used are perfectly correlated. A variety of auditory and visual stimulus dimensions, all perfectly correlated, will be used in order to determine the optimum display dimensionality for various types of information sources.

6. The Differential Discriminability of Pure versus Pulse Tones	Zeitlin	Aug 56	Jan 57

Audiometric and frequency discrimination tests are taken of a varying subject population. The relationship between hearing loss and the ability to discriminate small changes in frequency will be investigated by analysis of variance techniques.

7. Development of a Mobile Sound Laboratory	Fletcher	Jun 56	Jun 57

A 26 foot semi-trailer has been procured and is now being equipped to serve as a mobile sound laboratory. The laboratory will fulfill a primary mission of field audiometry and secondary missions of field sound level measurements, sound spectra determinations, and field noise recording.

The trailer will provide facilities for testing the hearing of 10 persons at once in a sound treated room. Standard audiometers will also be carried in order that individual audiometry can be done where the number of subjects would not make group audiometry profitable, or where other conditions would indicate individual testing. This will allow subjects to be tested right in the area in which they work, in areas where the noise level would normally preclude the determination of thresholds of hearing.

Organic to the trailer will be a 5 KW generator to supply the field power source for the equipment used in the field studies. Additional equipment carried in the trailer will include tape recorders, sound level meters, and sound analyzers. An adequate electronics repair and maintenance shop will be provided in order that field breakdowns of a minor nature not unnecessarily delay research.

This trailer will permit laboratory type research in the field away from usual laboratory facilities. Technological advances resulting in the increasing expenditure of energy, are drastically increasing the noise levels of the environments in which army personnel work. Some possible areas in which the sound laboratory will work will include studies of hearing losses among missile launching platform personnel and determination of hearing losses among recoiless rifle crew members. In March, 1956, AMRL was requested to investigate hearing losses in 57 recoiless rifle crew members by Frankford Arsenal, Philadelphia, Pennsylvania. If the mobile laboratory had then been available it could have been used for that purpose. Another field use of the laboratory might be to study the effect of certain artillery firing upon the hearing of crew members. On a larger scale, a field study could be made of the noise level and sound spectra of high noise level jobs in the army. Results of the study could aid in setting up an army-wide hearing conservation program. The value of an army hearing conservation program could be both immediate and considerable. A recent letter from the Veterans Administration reveals that there are now over 50,000 persons receiving compensation for service induced hearing loss. Assuming the minimum of 10% for those drawing disability pay (at the base rate of $16.67 per month), then the cost of service incurred hearing loss in disability pay alone is a minimum of $835,000 per month. A program that can reduce the number of persons incurring severe hearing loss will of necessity save the government millions of dollars over a period of time.

D. Environmental Factors

Title	Experimenter	Date Started	Estimated Completion Date
1. Effects of Auxiliary Topical Heat upon Manual Dexterity in the Cold	Peacock Newton	Mar 56	Oct 56

The use of auxiliary topical heat sources (such as chemical and electrical heating pads) in offsetting the deleterious effects of extreme cold upon manual dexterity is being investigated. Subjects perform a simple manual dexterity test repeatedly in a warm room and at -18°C., with varying amounts of topical heat applied to the forearm. Mackworth V tests are made before and after exposure. Preliminary results indicate that auxiliary heat applied to the forearm maintains digital temperature and dexterity at a level higher than that found in the unprotected subject exposed to the same cold stress.

2. Environmental and Internal Stress Effects upon Perceptual-motor Efficiency	Aiken	Apr 56	Sep 56

A self-paced multiple reaction time task is being used to study perceptual-motor blocking and other response decrements under stresses, both internal (response reversals) and external (ambient temperature).

3. Behavioral Effects of Cold Adaptation in the rat	Peacock	Jul 56	Oct 56

Normal and cold-adapted rats are being compared on various aspects of instrumental conditioning and extinction in an effort to determine behavioral concomitants of physiological cold acclimatization. Rats are trained to press bars for radiant heat reward and to traverse a runway for a heat reward, both situations occurring in varying low levels of ambient temperature.

4. Effect of Temperature Stress Upon Performance of Certain Tracking Tasks.	Newton	Sep 56	Jan 57

Movement and pressure tracking will be studied as a function of thermal stress. These two modes of tracking are differentially affected by temperature stress, according to a previous

study done in this laboratory. The present study will attempt to determine optimum temperature ranges for the two methods of control.

5. Fatigue and Response Decrement in a Complex Perceptual-motor Task	Aiken	Oct 56	Dec 56

Response decrement in a 4-stimulus, 4-response self-paced reaction time task is being studied. Task effortfulness is being varied by changing the number of responses required of the subject per unit time and noting the effects of this variable upon performance in a post-test in which different responses are required for the previously used stimuli.

E. Vestibular Section

Title	Experimenter	Date Started	Estimated Completion Date
1. Nystagmic Eye Movements During Interacting Vestibular Stimuli	Guedry Peacock Cramer	May 56	Sep 56

Nystagmic eye movements were recorded by amplification of corneo-retinal potential. In this experiment, negative angular accelerations followed positive angular accelerations with virtually no interval of constant angular velocity. Time from the onset of negative angular acceleration to a point midway between nystagmus of opposite directions is being measured.

2. Quantitiative Study of Nystagmus During Prolonged Constant Angular Acceleration	Guedry Koella	Jun 56	Jan 57

It is reported that vestibular nystagmus may terminate during prolonged low angular acceleration. This will be investigated with a variety of accelerations.

3. Latency of Onset of the Subjective Vestibular Response as a Function of Magnitude of Angular Acceleration	Guedry Richmond	Jul 56	Sep 56

Subjects received prolonged angular accelerations ranging in magnitude from $0.5^{\circ}/sec^2$ to $10^{\circ}/sec^2$. Average latency of onset of apparent rotation signaled by the subject varied from more than 10 seconds with the lower accelerations to less than 1 second with the high accelerations.

4. Adaptation Effects in Vestibular Reactions	Guedry Beberman	Jul 56	Oct 56

Subjects received angular accelerations of different magnitudes applied for times which theoretically would give equal cupula deviations, and hence equal post-stimulus reactions. Low magnitude accelerations would therefore be applied for longer periods than the higher accelerations. Results obtained to date indicate that the lower magnitude accelerations yield much shorter vestibular reactions than would be expected from theory of the cupula-endolymph system, whereas the higher magnitude accelerations yield reactions of expected durations.

5. Effects of Vibration of the Head on Acquired Behavior	Cramer Carlton	Apr 56	Nov 56

Preliminary research indicates that rats who have been anesthetized with barbiturates and then subjected to an hour's vibration of the head retain maze habits or straight alley running habits better than do the control animals, who are subjected to the same anesthetic but are not vibrated. There seems to be a tendency for the vibrated rats to perseverate in their learned behavior even though the reward for performance is reduced or abolished.

6. Cardio-vascular Effects of Prolonged Eccentric Angular Acceleration	Cramer Songster	Jun 56	Nov 56

Pulse rates have been determined in rats undergoing oscillations 90 cm from the center of a boom oscillating through 30-60° at rates of 40-60 cycles/min. The effect of this motion upon pulse rate depends upon the state of anesthesia of the animal. There is a depression in pulse rate in unanesthetized rats, with a return to pre-stress rates after an hour or two of oscillation. If the animal has been anesthetized with barbiturates, there is a rise in pulse rate for an hour or two, with recovery to the pre-oscillation rate.

7. Effects of Cold Stress upon Animals Previously Subjected to Kinetic Stress	Carlton Songster	Sep 56	Nov 56

A small population of rats will be anesthetized, and half of them will be subjected to vibration of the head. Twenty-four hours after this, all animals will be placed in individual cages in an ambient temperature of 33°F. Comparisions will be made between control and experimental in weight gains and in mortality.

8. Influence of Motion Sickness Preventative Drugs on Psychological Factors Involved in the Performance of various Military Duties	Cramer & others	Sep 56	Jun 57

The design of this study calls for the use of two motion sickness preventative drugs, one with slight side effects and one with strong side effects, and a placebo. Attention will be focused on three issues: (1) The importance of time intervals after ingestion of the drugs. (2) The side effects of the drugs. (3) The interaction between the side effects of the drugs and the time interval.

F. Blast Section

Title	Experimenter	Date Started	Estimated Completion Date
1. Effect of Blast on the Living Organism	Koella Silver	May 56	Continuing*

Most of the work done in blast investigation reveals a considerable pathological-anatomical concept; i.e., the effect of blasts (explosives) with respect to either microscopic and/or macroscopic injuries in different areas of the body was looked for. Since it should be the aim of the work to be performed in this Laboratory to supplement and extend, rather than to repeat those former findings, emphasis should be laid on the functional aspect of the problem. Consequently:

a. A series of physiological tests should be found which would furnish a reasonably complete picture of the functional state of the experimental animal. These should include tests elucidating the autonomic, sensorimotor coordinative and psychological state (see below).

b. These tests should be applied to experimental animals which were submitted to blasts under a variety of blast paramenters (peak pressure, impulse, pressure gradient, different positions in pressure field) either singly or repeatedly. The time of application of the tests after the blast should vary over a large range, in order to get information as to the duration, latency and time-course of any effects.

c. Preliminary work should be performed to find the range of different parameters which produce little or no overt (i.e. anatomical) injuries.

Emphasis should be put on those blast forms which produce faulty coordination as manifested by autonomic disbalance, deviated sensorimotor integration and changed (psychological) behavior.

d. All these tests should be performed on a considerably large variety of animals in order to get a basis for an extrapolation to man.

e. The studies of the blast effects should be paralleled by studies on the influence of vibration and jolt. A comparison of the results in all three fields of "generalized mechanical

*The following work is not under way but will be initiated upon completion of the blast tube.

traumatization" would offer an insight into certain common features of these different forms of trauma and certain special characteristic effects.

Finally these results could be compared to the effects of stresses of different nature such as cold, electroshock, severe pain.

Tests Suggested

A. Psychological Tests

B. Tests for Autonomic Balance

(1) Temperature (constant surroundings)
(2) Heart rate
(3) Pupils (constant illumination)
(4) Water-metabolism, membranes

(a) Water input-output, inulin clearance
(b) Hematocrit
(c) Water distribution in body (dye methods)
(d) Thirst-test, urine volume concentration

(5) Blood-brain barrier (radioactive tracers)
(6) Calorie-uptake, weight
(7) Reaction of blood pressure, heart-rate and nictitating membranes to injection of standardized amounts of adrenalin, acetylcholine or histamine. From this an indication of "vagotonic" or "sympatheticotonic" animal could be evaluated.
(8) Reaction of above indicators (7) to standardized hypothalamic stimulus (implanted electrodes).

C. Tests for Sensorimotor Integration

(1) Position and posture of animal (films)
(2) Gait, normal and under difficult situation
(3) Positioning effects on eyes upon tilting (quantitative evaluation)
(4) Nystagmus duration after acceleration or deceleration
(5) Vestibule-optokinetic integration (turntable with turning black-white cylinder).

G. Vibration Research

Title	Experimenter	Date Started	Estimated Completion Date
1. Effect of Vibration on the Living Organism	Collins	Jan 56	Continuing

A program of research is being carried on to evaluate the effect of vibration on human performance. The primary purpose of this research is to investigate the effects of repeated exposure to vibration when the intensity of any single stimulus is below the lethal level. There are three research areas in this program. The first is concerned with the evaluation of changes in behavior which occur when the organism is subjected to controlled vibration. The second is concerned with the physical nature of the stimulus itself, such as the characteristics of the stimulus in terms of velocity or acceleration, the energy applied to and absorbed by the body, the periodicity of the stimulus and the overall duration. The third area of interest lies in the field of prophylaxis. It is expected that the information to be gained from these experiments can be used to reduce the number of casualties.

The work in the past has been concerned with the effects of prolonged exposure to vibration upon various kinds of sensory and motor performance in the human. The current program is concerned with an evaluation of the traumatic anatomical changes in monkeys as a function of exposure to vibration near or at the lethal level. This work is being carried out by the Pathology Department, using the facilities of the Psychology Department.

IV. PUBLISHED REPORTS
Psychology Department
Army Medical Research Laboratory

Report No. 214, 6 October 1955. An investigation of pure tone thresholds following narrow band filtered noise. John L. Fletcher.

Report No. 215, 12 January 1956. The sensing of relative distance. W. C. Gogel and J. A. Schneps.

Report No. 216, 17 January 1956. The judgment of angular positions in the horizontal plane on the basis of kinesthetic cues. L. S. Caldwell and M. J. Herbert.

Report No. 218, 15 February 1956. The effects of noise on eye movements. J. Krauskopf, P. D. Coleman and R. Kalla.

Report No. 221, 27 January 1956. The effects of retinal image motion on contrast thresholds. J. Krauskopf and R. Kalla.

Report No. 222, 1 December 1955. The influence of high intensity noise on visual thresholds. Paul D. Coleman and John Krauskopf.

Report No. 223, 6 April 1956. Frequency discrimination of pure and pulse tones. R. Cramer and L. Zeitlin.

Report No. 225, 7 March 1956. Combined environmental stresses and manual dexterity. Edwin G. Aiken.

Report No. 230, 11 April 1956. A field study of a vigilance task. Michel Loeb, Gabriel Jeantheau, and Lelon A. Weaver w/technical assistance of R. George Richmond.

Report No. 231, 18 April 1956. A field study of rifle aiming steadiness and serial reaction performance as affected by thermal stress and activity. L. J. Peacock.

Report No. 232, 20 April 1956. Note on the operation of the standard electric timer from storage batteries by use of a current converter. J. M. Newton.

Report No. 233, 27 April 1956. The accuracy of constant angular displacement of the arm in the horizontal plane as influenced by the direction and locus of the primary adjustive movement. L. S. Caldwell.

Report No. 235, 9 May 1956. The retinal size of a familiar object as a determiner of apparent distance. W. C. Gogel, B. O. Hartman, G. S. Harker, K. Inaba, R. E. Page and J. J. Cox.

Report No. 236, 23, April 1956. "BETA" - A special purpose computer for studies in the human control of complex equipment. Bryce O. Hartman, John K. Wetherbee, Woodrow Bates and George Potenza.

Report No. 239, 24 May 1956. Judgments of visual velocity as a function of length of observation time. A. G. Goldstein and L. K. Williams.

Report No. 242, 23 May 1956. Description of Human Rotation Device. F. E. Guedry, Jr. and Harvey Kalter.

Report No. 245, 28 June 1956. Graphic time-on-target: a tracking score with both qualitative and quantitative aspects. Bryce O. Hartman.

Report No. , in press. The effects of noise on work output and physiological activation. M. M. Helper.

Report No. 248, October 1956. Further studies on frequency discrimination of pure and complex tones: Part II. L. R. Zeitlin and R. L. Cramer.

Report No. , in press. The effect of intense stimulation on the perception of time. M. Loeb and R. George Richmond.

Report No. 260, in press. The speed and accuracy with which six linear arm movements can be visually positioned from two different control locations. Marvin J. Herbert.

Report No. 258, in press. Judgments of visual velocity as a function of the length of observation time of moving or non-moving stimuli. Alvin G. Goldstein and L. K. Williams.

Report No. 261, in press. Some effects of interacting vestibular stimuli. F. E. Guedry.

Report No. , in press. The relative loudness of pure and complex tones. Lawrence R. Zeitlin.

Report No. , in press. The effect on target frequency on pursuit tracking. Bryce O. Hartman.

Report No. , in press. A survey of hearing losses among armored personnel. John L. Fletcher and Lawrence N. Solomon.

PSYCHOPHYSIOLOGICAL STUDIES CONDUCTED BY CONTRACT

Research and Development Division
Office of The Surgeon General

1. "Effects of Noise on Perception of Forms in Electrovisual Display Systems", by Dr. Mason N. Crook, Department of Psychology, Tufts College, Medford, Massachusetts (MD-536)

   Study of discrimination of forms in relation to confusion of visual backgrounds. This study is designed to obtain basic information concerning several aspects of visual perception in terms of confused visual stimuli.

2. "Sensing Mechanisms in Control of Fine Movements in Perceptual Motor Precision and Performance", by Dr. Edward Girden, Department of Psychology, Brooklyn College, Brooklyn, New York (MD-625)

   Study of the effect of fatigue on motor precision and perception in a tracking problem.

3. "Factors Influencing Complex Decision-Making Behavior", by Dr. Richard Henneman, University of Virginia, Department of Psychology, Charlottesville, Virginia (MD-537)

   This is an attempt to obtain data concerning the psychophysiological mechanisms involved in information processing. The relationship between sensory inputs and the factors impinging on degradation of stimuli characteristics, and the alternatives leading to a decision, are systematically varied.

4. "Effect of Overstimulation and Internal Factors on Function of Inner Ear", by Dr. Merle Lawrence, Institute of Industrial Health, University of Michigan, Ann Arbor, Michigan (MD-634)

   This is a study of the inner ear structures responsible for distortion, the relationship between distortion and the physiological condition of the organs of Corti.

5. "Psychophysiology of Perception", by Dr. Donald B. Lindsley, Department of Psychology, University of California, Los Angeles, California (New Contract - work began 1 September 1956)

   This study is to attempt to identify certain aspects of visual perception which may have valuable relationships to auditory and tactual perception. The approach will combine psychophysiological methods with electro-physiological data, such as EEG and ERG.

6. "Certain Physiological Correlates of Psychomotor Functioning", by Dr. Robert B. Malmo, McGill University, Montreal, Canada. (MD-626)

This is an attempt to obtain an objective measure of an aspect of motivation indicated by electromotor gradients. Additionally, neuro muscular relationships in tracking and other performance variables will be explored in terms of degradation of function.

7. "Neural Correlates of Thermal Sensations", by Dr. John P. Nafe, Florida State University, Tallahassee, Florida (MD-683)

   Study of the relationship of receptor organ to nerve tissue to obtain data supporting hypotheses concerning movement of the nerve tissue to bring about neural discharge. The psychophysiological correlates of thermal sensation will also be explored.

3. Quartermaster Research & Development Center, U. S. Army
Natick, Massachusetts

Psychology Branch
Environmental Protection Research Division

I. Organizational Chart

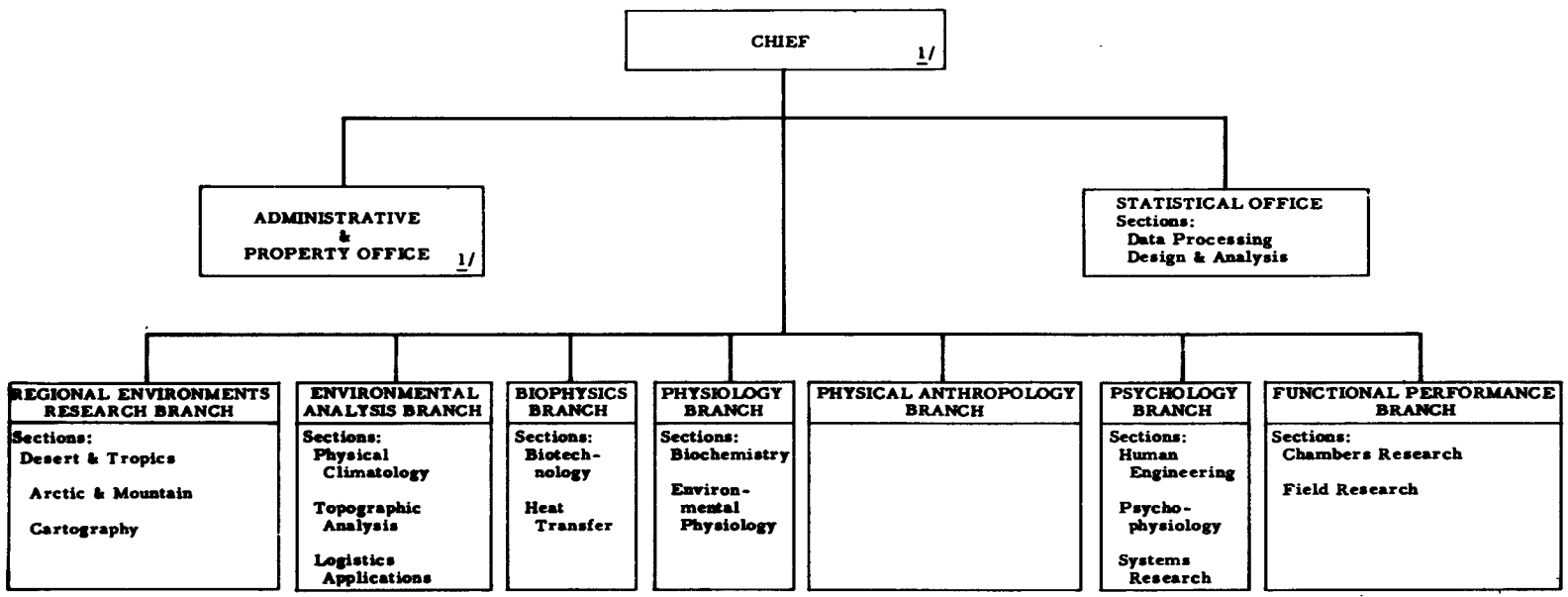
II. Bibliography of Studies Completed Since the First Annual Army Human Engineering Conference

III. List of Human Engineering Professional Staff

IV. Current Human Engineering Research Program

DEPARTMENT OF THE ARMY
QUARTERMASTER RESEARCH & DEVELOPMENT COMMAND
QM R&D Center Operations

ENVIRONMENTAL PROTECTION RESEARCH DIVISION



1/ Assistant to the Chief also serves as Chief, Administrative & Property Office

II. BIBLIOGRAPHY OF STUDIES COMPLETED SINCE THE FIRST ANNUAL ARMY HUMAN ENGINEERING CONFERENCE

A. Technical Reports

(1) The Reliability and Intercorrelations of Eight Tests of Body Flexion. Technical Report EP-31, Headquarters Quartermaster Research and Development Command, Natick, Mass. E. R. Dusek and W. H. Teichner.

(2) Accustomization and Indoctrination Studies Relating to Cold Weather Living and the use of Quartermaster Clothing and Equipment. Technical Report EP-32, Headquarters Quartermaster Research and Development Command, Natick, Mass.
Arthur J. Riopelle (Contract DA-44-109-QM-1129)

(3) Soldier Acceptance Research Studies, Chapter V in "The Effects of Continuous Wear of the Coldbar Uniform." Technical Report EP-18, Headquarters Quartermaster Research and Development Command, Natick, Mass.
J. M. McGinnis.

(4) QM Human Engineering Handbook Series: I. Spatial Dimensions of the 95th Percentile Arctic Soldier. Technical Report EP-39, Headquarters Quartermaster Research and Development Command, Natick, Mass.
J. L. Kobrick.

B. Research Study Reports (Limited Distribution)

(1) Acceptability and Human Engineering Study of Rocket Fuel Handlers' Suits at Fort Churchill During January and February 1956, J. M. McGinnis, Research Study Report, Psychology Branch, Environmental Protection Research Division, QM R&D Command, Natick, Mass., April 1956. (CONFIDENTIAL)

(2) Human Engineering Evaluation of Radical Arctic Handwear Systems, I. A Comparative Study of the Experimental Chinese Sleeve and the Standard Arctic Mitten Ensemble, J. L. Kobrick, Research Study Report, Psychology Branch, Environmental Protection Research Division, QM R&D Command, Natick, Mass., April 1956.

(3) Evaluation of Experimental Arctic Handwear in Terms of Manual Performance, W. C. Roehrig, Research Study Report, Psychology Branch, Environmental Protection Research Division, QM R&D Command, Natick, Mass., May 1956.

(4) Human Engineering Design Study of the Acid and Fuel Handler's Suit, J. L. Kobrick, Research Study Report, Psychology Branch, Environmental Protection Research Division, QM R&D Command, Natick, Mass., July 1956.

(5) Human Engineering Evaluation of the Wood-Hafferty Cold Weather Face Mask, Henry F. Gaydos, Research Study Report, Psychology Branch, Environmental Protection Research Division, QM R&D Command, Natick, Mass., July 1956.

C. Contract Final Reports (Unpublished)

(1) Studies of Some Variables Relating Hand Covering Design to Manual Performance in Extreme Environments. QM R&D Command, Contract DA-44-109-QM-1531.

(2) The Acceptability of Hand and Foot Gear and the Sleeping Bag Used During Exercise Snowbird: A Motivation Research Study. QM R&D Command, Contract DA 19-129-QM-320.

(3) A Research Study of the Acceptance of Quartermaster Clothing and Equipment. QM R&D Command, Contract DA-44-109-QM-1725.

(4) Changes in the Distribution of Muscular Tension During Psychomotor Performance. QM R&D Command, Contract DA-19-129-QM-250.

(5) Comparison of Hand and Arm Function With and Without Restriction of Heavy Clothing. QM R&D Command, Contract DA-44-109-QM-1760.

III. LIST OF HUMAN ENGINEERING PROFESSIONAL STAFF

All personnel of the Psychology Branch and of the Anthropology Branch participate in human engineering research and consultation.

The following list provides the names of the professional staff of these branches.

1. Psychology Branch: Chief, Dr. Warren H. Teichner
   a. Human Engineering Section: Chief, Dr. Henry F. Gaydos
      Dr. Bernard J. Fine
      Dr. Donald Haggard
      Mr. Eaton K. Jones

b. Psychophysiology Section: Chief, Dr. E. Ralph Dusek
Dr. John L. Kobrick
Mr. William C. Roehrig
Pvt. Allen W. Mills

c. Systems Research Section: Chief, Dr. John M. McGinnis
Capt. William S. Wolf
2d Lt. Vernon L. Allen

2. Anthropology Branch: Chief, Dr. Russell W. Newman
Dr. Thomas W. McKern
Dr. Paul T. Baker
Mr. Robert M. White

IV. CURRENT HUMAN ENGINEERING RESEARCH PROGRAM

The following list of research work phases represents the joint effort of the Human Engineering, Psychophysiology and Systems Research Sections of the Psychology Branch, Environmental Protection Research Division. Whereas the Human Engineering Project deals more directly with end item development, experience has shown that such work cannot be properly carried out without the support of the more fundamental research programs of the Psychophysiology and Systems Research Sections. In view of this the work phases listed under the projects of these sections have been included.

All work phases listed will show significant progress by the end of Fiscal Year 1957.

ENVIRONMENTAL PROTECTION RESEARCH DIVISION

EFFECTS OF NATURAL AND MILITARY ENVIRONMENTS ON THE SOLDIER (R&D)

Res. Project No. 7-83-01-003

A. Effects of Combined Environmental Stress on the Soldier — Priority

1. Determination of the psychological effects on the soldier of loss of sensory contact with his environment, anticipated from the present trend toward completely enclosing the soldier with protective clothing systems. — 1

2. Investigation of the effects of radiant heat on skin sensations, to develop methods for evaluating the degree of protection from low intensity thermal radiation.

   a. Investigation of the area-time function of skin sensations of warmth and stinging.

   b. Investigation of the objective differences between sensations of warmth and other heat sensations of the skin.

3. Establishment of controls, norms and reliabilities to use in the development of sensory, gross motor and psychomotor testing devices.

(Northeastern University)

4. Establishment of general-purpose thermal comfort scales as an index of the environmental effect on the soldier, through comparison of various psychophysical scaling techniques.

5. Investigation of the relationships between body temperatures, body characteristics, various clothing combinations, thermal comfort, and psychomotor performance, in order to determine requirements for protection.

Priority

a. Investigation of the effects of heat and humidity on complex coordinative performance and thermal comfort.

b. Investigation of the effects of body temperatures, low ambient temperatures and wind on the soldier's speed of reaction.

c. Investigation of the relationship of morphological criteria (fat, muscle, etc.) to hand performance in cold environments.

d. Investigation of the relationship of the pressure sensitivity of the hand to manual skills and hand temperature in cold environments.

e. Investigation of the relationship of the tactual-kinesthetic sensitivity of the hand to skin temperature and to manual skills.

f. Investigation of the effects of environmental factors and handwear design on hand function.

6. Investigation of the combined effects of sleep deprivation and climatic extremes on psychological and psychophysiological functions.

7. Investigation of the preference reactions of soldiers to QM items of clothing and personal equipment, in order to evaluate the degree to which the soldier willingly retains and utilizes these items under field conditions.

a. Investigation of psychological factors affecting the soldier's preference for footwear and comparison of methods for evaluating the importance of these factors.

b. Investigation of differences in preference reactions of airborne and regular troops.

B. Principles for Providing Environmental Protection — 2

1. Investigation of the feasibility of simplifying electroencephalographic techniques for determining the amount of sleep obtained by soldiers in sleeping bags.

(Tufts University)
(In collaboration with TC&F)

2. Evaluation of the Alertness Indicator as a Method for detecting differences in the amount of sleep afforded by sleeping gear in low temperature.

NATURE AND DISTRIBUTION OF SIGNIFICANT FACTORS IN MILITARY ENVIRONMENTS (R&D)

Res. Project No. 7-83-01-002

A. Factors in the Military Environment that Influence the Operational Effectiveness of the Soldier — Priority

1. Determination of factors in the military environment that are significant in terms of their critical effect on the operational effectiveness of soldiers and materiel. — 1

a. Study of the character of low-intensity noises under different field conditions to determine new acoustic

Priority

transmission requirements of headgear for adequate hearing, speech, and localization of sound.

(See Project 7-79-10-001B)
(Contractor to be determined)

b. Determination of critical factors involved in current use of missile fuel handlers clothing to provide a basis for physiological and human engineering evaluation of the ensembles.

B. Extent and Distribution of Natural and Military Environmental Interactions

1. Survey of R&D effort in the development of special protective clothing systems to determine trends which may result in new and critical factors that adversely affect the soldier. 2

OPERATIONAL EFFECTIVENESS OF THE QM-EQUIPPED SOLDIER (R&D)

Res. Project 7-83-01-004

A. Human Engineering of QM Items — Priority

1. Collection and presentation of data on anthropometric and psychophysiological characteristics of the military population required for human engineering of QM items. 1

a. Analysis of special hand dimensions (relaxed hand shape, thumb-crotch, and finger lengths) as design guidance criteria.

b. Investigation of the dimensional parameters of the soldier's neck-shoulder area during movement to establish design criteria on work and equipment space-potential for this portion of the body.

c. Collection and analysis of a basic reference series of head and face data based on contour relief photographs to provide design reference criteria.

d. Analysis of head and face dimensions to provide guidance for clothing and equipment design.

e. Study of the contour of the ankle as a basis for making refinements in the ankle area of the last for insulated boots and other combat footgear.

(Requested by TC&F)
(In conjunction with FEA 55024)

f. Anthroposcopic and anthropometric research on a series of approximately 50,000 body-build photographs furnished by the government.

(Harvard University)

g. Determination of the ability of the arm to reach across the body in various directions for various body postures, the spatial dimensions of the body while so engaged, and the ability to perform tasks with the hand at the limit of reach for application to the placement of clothing and personal equipment.

Priority

h. Determination of the range of movement of the critical joints of the foot, the relation of these parameters to dimensional measures of the foot and to foot fatigue and the effects of footwear on these measures and on foot fatigue.

(State University of Iowa)

i. Determination of the movement and endurance functions of the hands and fingers for application to handwear problems.

(State University of Iowa)

j. Studies of the design variables in hand protection items and quantification of the effects of these variables on manual performance.

(University of California at Los Angeles)

k. Development of a human engineering handbook of hand function and hardwear design for the guidance of handwear and equipment designers.

l. Development of a human engineering handbook of the ear and acoustic requirements of ear-covering items for the guidance of headwear designers.

m. Development of human engineering handbooks of the spatial dimensions of the QM-equipped soldier.

2. Studies of soldier-equipment-environment systems to insure incorporation of sound human engineering principles and to effect compatibility between items.

a. Human engineering design studies of the rough terrain fork truck.

b. Study of experimental QM items of clothing and personal equipment, as required, to provide human engineering and anthropometric design guidance. 1

(1) Study of the feasibility of integrating portions of the present women's cold-weather uniforms with men's wet-cold and dry-cold ensembles.

(Requested by TC&F - 5204)

(2) Sizing study of experimental cold-weather headgear designed for wear under one-piece head armor.

(Requested by TC&F - 5608)
(In conjunction with FEA 56033)

(3) Human engineering studies of the functional characteristics, vision, and freedom of movement afforded by an experimental helmet camouflage cover with havelock.

(Requested by TC&F - 5609)

(4) Sizing study on missile fuel handlers clothing (T55-5) to determine whether issuing of an extra size or sizes of the protective garment will permit the item to be used under hot weather conditions.

(Joint program w/FC&F - 5611)

	Priority
3. Establishment and implementation of procedures to insure compatibility between QM experimental and standard items and experimental and/or standard items of the other Technical Services.	
a. Study of the nature and extent of functional conflicts of QM designed clothing and personal equipment with equipment supplied by other Technical Services and with other QM equipment. (Psychological Research Associates)	1
b. Survey of the Technical Services to determine areas of interest where collaboration is required to insure compatibility of QM clothing and equipment with other Army materiel.	
B. Operational Analyses of the Soldier-Environment-Equipment Complex	
1. Determination of the operational requirements of the QM-equipped soldier, through analysis of troop operations.	5
a. Determination of requirements for improved methods of instruction in the use of QM items in the Arctic through operational analysis of the performance of troops.	
b. Determination of requirements for eye protection in Arctic areas, through operational analysis.	

4. TRANSPORTATION RESEARCH & DEVELOPMENT COMMAND

Fort Eustis, Virginia

Prepared for

2nd Annual Army Engineering Psychology Conference

7 - 9 November 1956

Transportation Research and Development Command

1. Subsequent to April 1956 human engineering has been added as a part of the General Research Branch, Special Projects and Analysis Division.

2. The human engineering professional staff includes one person, Dr. John W. Bailey.

3. No projects have been completed since the last conference; therefore, there is no bibliography of in-service or contract human engineering studies.

4. Tasks currently being initiated include:

The original prototype of the Logistical Cargo Carrier, which was manufactured without benefit of human engineering, is on hand at TRADCOM for extensive testing.

As a result of this testing a second model, containing necessary modifications, will be manufactured. During the rather lengthy period of this test, a human engineering study will be made, particularly of the cab and control section which will house a crew of four (4).

5. SIGNAL CORPS ENGINEERING LABORATORIES

Fort Monmouth, New Jersey

REVIEW

Prepared for 2d Annual Army Engineering Psychology Conference - 7-9 November 1956

I. **Projects Completed Since October 1955**

II. **List of Professional Staff**

III. **Current Human Engineering Tasks**

I. Projects Completed Since October 1955

A. Reports prepared by Dunlap and Associates, Inc., Contract No. DA-36-039 SC-64647.

1. Final Report on Task .02 - Human Engineering Review of Radar Set AN/MPQ-4. (Unclassified Title)

2. Final Report on Task .05 - Human Engineering Review of the Manual Telephone Switchboard SB-86/P and the Central Office, Telephone Manual AN/TTC-5.

3. Final Report on Task .06 - Design of Certain Features of a Data Processing Central (Unclassified Title).

B. Reports prepared by the University of Pennsylvania, Institute for Cooperative Research, Project WESCOM, Contract DA-36-039 SC-63143.

1. Effects of Excess Information on Speed of Information Processing by Human Beings - Report No. EQ-5-005-03, 31 October 1955.

2. Effects of Redundant Information on Speed of Information Processing by Human Beings - Report WE-56-U-M-1, 30 April 1956.

3. Presentation: (I) The Effects of Symbol and Positioned Preferences on Response. Report No. WE-56-U-M-2, 15 May 1956.

4. A study of Methods of Evaluating Information Processing Systems of Weapons Systems - Report WE-56-U-M-3, 30 July 1956.

5. Experimental Test of a General Model of Decision Behavior - WE-56-U-M-4, 1 August 1956.

6. Inquiry into the Decision Process. Report No. WE-56-U-M-5, 1 August 1956.

II. List of Professional Staff

A. Personnel assigned full time to the SCEL Human Engineering Program in the Office of Engineering Operations:

Mr. P. E. Griffith, Human Engineering Coordinator
Mr. D. L. Huebner
PFC D. C. Mertz

B. Part time assignment:

Radio Communication Division - Mr. R. M. Ireland
Countermeasures Division, Detection and Location Branch - Mr. S. J. Lanzalotti
Radar Division, Radar Systems Branch - Mr. Jerome Weiss

III. Current Human Engineering Tasks

A. The Signal Corps Engineering Laboratories Human Engineering Program is not presently concerned with internal or external research, except that of a basic nature being conducted at AMRL. The current concept of the mission is application of human engineering principles to signal equipments and systems during their research and development phases. Results of human engineering research are used wherever possible and needs for additional information are derived from the work. A considerable part of the program is devoted to training technical personnel in the elemental aspects of human engineering and in system analysis.

B. Some human factors research is being done by contractors as a part of larger programs. Project WESCOM personnel are studying the Analysis of Human Errors in Information Processing and the effect of Inertia in Choice or Decision making. Other subjects under continuous study are automation, organization, override and information processing in weapons communication systems. Airborne Instruments Laboratory is nearing completion of its human engineering study of the surveillance radar station mentioned at the First Army Human Engineering Conference.

6. Research and Development Command
Chemical Warfare Laboratories
Army Chemical Center, Maryland

I. Organization Chart

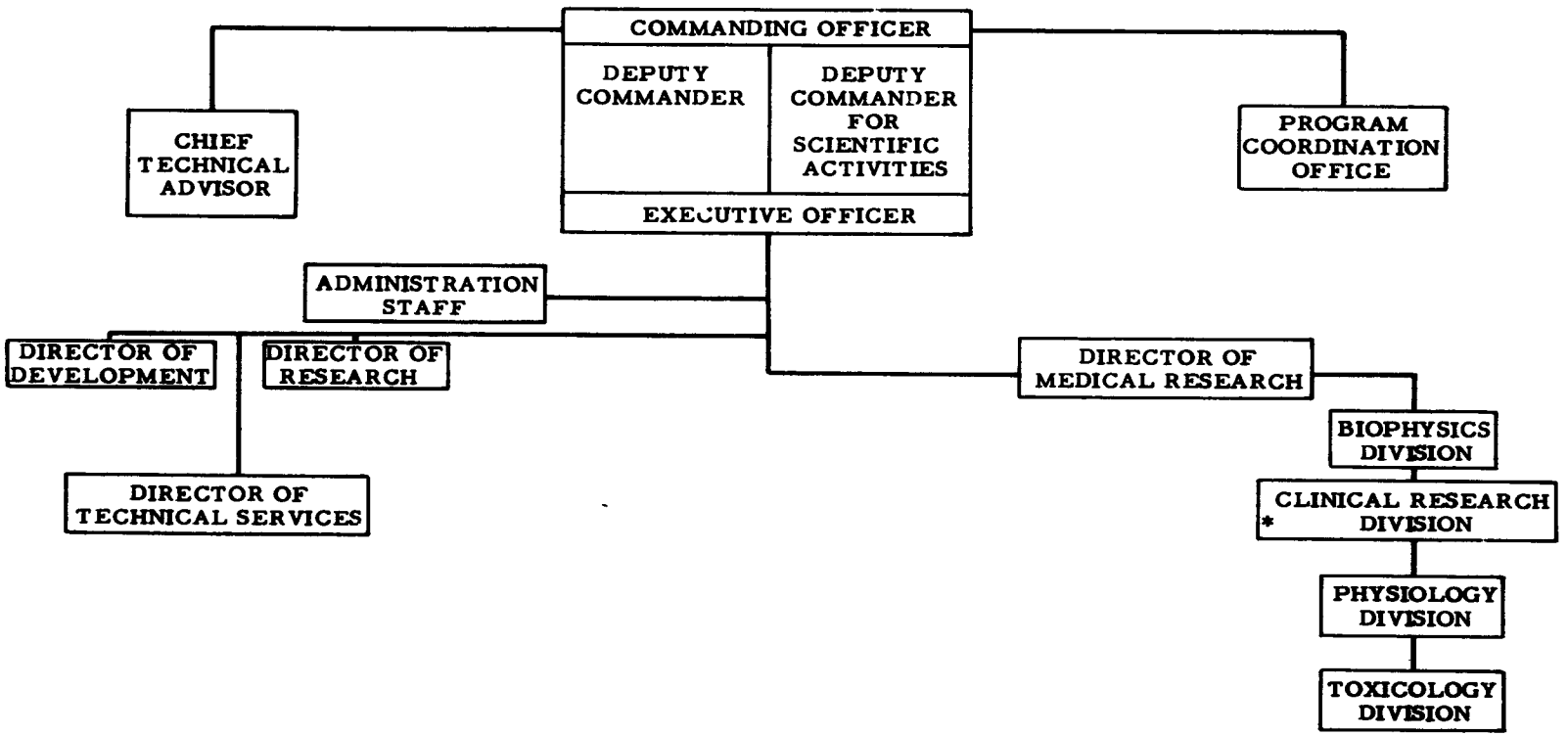
II. General

III. List of Human Engineering Staff

IV. Current Human Engineering Research Program

V. Mission of the Clinical Research Division

RESEARCH AND DEVELOPMENT COMMAND
CHEMICAL WARFARE LABORATORIES
Army Chemical Center, Maryland



II. General

The asterisk in the Clinical Research Division of Directorate of Medical Research indicates the only place where the Chemical Corps has a definitive human engineering organization.

III. List of Human Engineering Staff

Chief, Dr. Leonard Rubin
Dr. Earl Davy
Dr. Frank Rosenberg

IV. Current Human Engineering Research Program

Some human engineering tasks being conducted by the Chemical Corps' professional staff are classified and cannot be listed here. However, one task "The Effects of GB in Sublethal Concentrations on Human Behavior" is being conducted in the Chemical Warfare Laboratories. It is hoped that this task will be completed in the FY 1957. The objective is to ascertain the anticipated reactions and behavior of personnel who might be subjected to low concentrations of GB and what effect this might have on the conduct of prescribed duties of these personnel under these conditions.

V. Mission of the Clinical Research Division

The mission of the Clinical Research Division is apportioned among the following branches:

Clinical Investigation
Neurology
Pathology
Psychology and Human Engineering

The responsibilities of the Psychology and Human Engineering Branch includes:

a. Conducting research on the human engineering and design of human tasks, man machine systems, and specific items of man operated equipment for the most effective accomplishments of military missions involving use of CW Materiel.

b. Evaluation of human limitations on performance of military activities imposed by the characteristics of offensive and defensive CW Materiel under various environmental conditions.

c. Conducting research on the psychophysiological effects of sublethal concentrations of CW Agents on humans and animals.

d. Conducting research on the relation between psychological changes and underlying neurophysiological mechanisms.

e. Conducting research on the psychophysiological effects of certain well established and recently synthesized drugs.

7. Materials For Working Groups

2d Annual Army Engineering Psychology Conference
7, 8 and 9 November 1956
Fort Knox, Kentucky

WORKING GROUP A

Joint Services Steering Committee Handbook
for Design Engineers.

TERMS OF REFERENCE

1. "Conference Report," Army Human Engineering Conference of 14-15 December 1955, pages 14-18, presents relevant recommendations of previous Conference and background of these recommendations.

2. Proposed agenda item "Summary of Army Actions Taken on Recommendations of Previous Conference" at 1040 hours on 7 November 1956 will summarize actions taken on these recommendations.

3. Appendix A, contains listing of Army personnel designated by technical services, in accordance with recommendation of "Report" (para 1), to represent the needs of design engineers in a critical review of each of the chapters of the Human Engineering Guide.

4. "The Design and Conduct of Human Engineering Studies" by Alphonse Chapanis, dated July 1956 (Inclosure 10) is currently being considered for incorporation in or annexure to the Human Engineering Guide. Comments and recommendations of the Working Group will be addressed to questions raised in "Forward" (page iii) of this paper and to advisability of incorporating materials from this paper in the Human Engineering Guide.

5. Membership of Working Group A is indicated in Inclosure 9.

Personnel designated by their organization to make critical review of chapters of the Human Engineering Guide

Lynn E. Baker, Chairman
Army Member, Executive Council
Joint Services Steering Committee
Human Factors Research Division, OCR&D

Mr. Burwell Bennett
Engineer Research & Development Laboratories
Ft Belvoir, Virginia

Dr. Ben Ami Blau
Ordnance Corps
Aberdeen Proving Ground, Md.

Dr. Henry F. Gaydos
QM Research & Development Command
Natick, Massachusetts

Mr. T. M. Vining
Chief, Statistical Engineering Unit
Chemical Corps Engineering Command
Army Chemical Center, Md.

Dr. John W. Bailey
Transportation Research & Development Command
Ft Eustis, Virginia

Mr. Paul E. Griffith
Signal Corps Engineering Laboratories
Ft Monmouth, N. J.

2d Annual Army Engineering Psychology Conference
7, 8 and 9 November 1956
Fort Knox, Kentucky

WORKING GROUP B

Training of Army Officers in
Engineering Psychology

TERMS OF REFERENCE

1. "Conference Report," Army Human Engineering Conference of 14-15 December 1955, page 20, presents suggestion of Dr. Paul Fitts that there is a need for personnel who can "bridge the gap between the design engineer and the research scientist (in engineering psychology)."

2. Letter to CONARC and DF to the technical services from C/R&D dated 19 April 1956, subject "Graduate Training in Human Engineering," transmitted a letter on this subject from Lt Col John E. Aber to TAG through C/R&D which suggested that a number of Army officers be given graduate training in the field of engineering psychology under the civil schooling program, these officers to serve their utilization tours in R&D agencies. Transmittal suggested that addressees evaluate benefits to be anticipated from appropriate action in accordance with AR 350-200.

3. Comment 2 to above DF, dated 30 August 1956 from OQMG, suggests that: (a) the Army initiate such a program on the basis of one officer per year from each technical service and arm; (b) at the end of a 5-year period, graduates be reviewed in respect to their contributions to Army problems and effectiveness of utilization and assignment; and (c) before such a program is initiated, agreement be reached with career-planning echelons and military manpower control as to the probability of assignment consistent with this graduate training.

4. OCR&D has initiated action under AR 350-200 for civil school graduate training of one officer for this purpose, but finds that few officers of appropriate qualifications appear aware of the needs and opportunities in this field.

5. Comments and recommendations of the Working Group will be addressed to:

a. Determination of the qualifications which should be required for officers to receive such graduate training.

b. Subject matter which should be included in such graduate training (it is anticipated that Dr. Paul Fitts and Dr. Daniel Howland, Ohio State University, will be present to consult with the group on this matter).

c. Methods which might be used to inform appropriately qualified officers of the needs and opportunities in this field.

6. Membership of Working Group B is indicated in Inclosure 9.

2d Annual Army Engineering Psychology Conference
7, 8 and 9 November 1956
Fort Knox, Kentucky

WORKING GROUP C

Human Factors in Design of Equipment For
Use in Arctic Climates

TERMS OF REFERENCE

1. DF, file CRD/E 9441 U, dated 10 July 1956, from C/R&D, subject: "Second Annual Army Human Engineering Conference," requested (para 4) suggestions for problems meriting assignment to working groups at this Conference.

2. Comment 2 to para 4 of above DF, dated 6 August 1956, from CofEngrs, suggested "consideration of Human Engineering needs in the design of equipment for use in extreme cold climates."

3. It can be assumed that Arctic and ice-cap operations may be planned in future and that such opportunities as these offer may be exploited for improvement of equipments as respects human factors in performance.

4. Comments and recommendations of the Working Group will be addressed to such questions as the following, e.g.:

a. Are there opportunities which should be exploited for observation in Arctic or ice-cap operations of human factors in equipment design?

b. Are there differences among the technical services in the degree to which human factors influence performance of their equipments in arctic and ice-cap operations?

c. Is there a requirement for sending observers to future arctic or ice-cap operations to obtain information on above and related questions? Is it feasible on the basis of available information to design and conduct experimental tests of human factors in such operations in advance of reports from such observers?

d. Which equipments, on the basis of current information, should be recommended for such experimental tests? How much performance degradation is to be anticipated as attributable to human factors in arctic environments for these equipments?